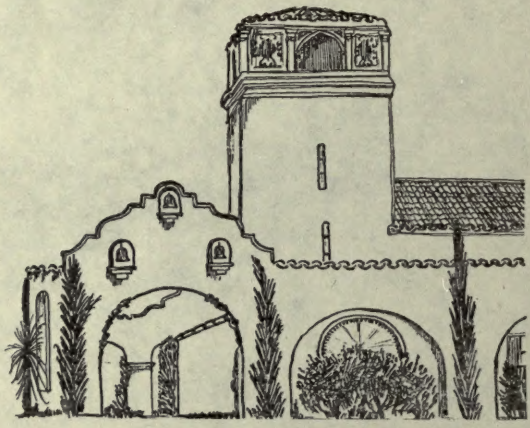

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A MANUAL OF SURGICAL TREATMENT

CHEYNE AND BURGHARD'S
MANUAL OF SURGICAL TREATMENT.

CONTENTS OF THE VOLUMES.

VOLUME I.

The Treatment of General Surgical Diseases, including Inflammation, Suppuration, Ulceration, Gangrene, Wounds and their Complications, Infective Diseases and Tumours, Deformities.

With an Appendix upon the Administration of Anæsthetics by DR. SILK, and the Examination of the Blood by DR. W. D'ESTE EMERY.

VOLUME II.

The Treatment of the Surgical Affections of the Skin and Subcutaneous Tissues, the Nails, the Lymphatic Vessels and Glands, the Bursæ, the Muscles, the Tendons and Tendon Sheaths, the Nerves, the Blood Vessels and the Bones: Amputations.

VOLUME III.

The Treatment of the Surgical Affections of the Joints, the Spine, the Head and the Face.

VOLUME IV.

The Treatment of the Surgical Affections of the Jaws, Tongue and Alimentary Canal.

VOLUME V.

The Treatment of the Surgical Affections of the Pancreas, Liver and Spleen, the Genito-Urinary Organs, the Larynx and Neck, the Thorax and the Breast.

A Manual of Surgical Treatment

BY

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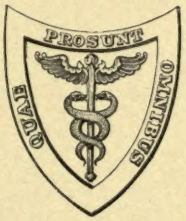
In Five Volumes

VOL. IV.

The Treatment of the Surgical Affections of the Jaws, Tongue and Alimentary Canal



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1913

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TO

THE RIGHT HON.

LORD LISTER, O.M., LL.D., F.R.S.

THE FOUNDER OF MODERN SURGERY
WITHOUT WHOSE WORK MUCH OF THIS BOOK
COULD NOT HAVE BEEN WRITTEN.

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PREFACE

TO

REVISED EDITION.

SINCE the first edition of this work was published many changes have naturally occurred in the field of Surgical Treatment. Attempts have been made from time to time to incorporate the most essential of these in successive impressions, but it is always difficult to interpolate new matter of this kind satisfactorily without extensive revision of the entire work. It has therefore seemed best to revise the matter throughout and to alter in it whatsoever was necessary to bring it up to date. The original scheme of the work has been adhered to; to depart from it would have been to abandon the fundamental idea upon which it was based. Every part of the book, however, has been thoroughly revised, and a considerable part has been re-written.

The pressure of other work rendered it impossible for the original authors to undertake a task of such magnitude with any hope of being able to complete it within a reasonable time. In Messrs. T. P. Legg and Arthur Edmunds they have been fortunate in securing collaborators who have rendered their task possible, and to them they are under a great obligation. To their colleagues Dr. Silk, Dr. D'Este Emery, Dr. Arthur Whitfield and Mr. A. D. Reid, they are also much indebted for help in the several departments of treatment with which these gentlemen are specially concerned. Mr. Arthur Edmunds, in addition to his share in the revision, has provided a number of the new illustrations; Messrs. F. Butterworth and S. A. Sewell have drawn the remainder.

Messrs. Down Bros., Allen & Hanburys, Barth, and others have kindly allowed the reproduction of many instrument blocks from their catalogues. Other figures have been reproduced by permission of their authors or publishers, and the source from which they are derived will be found duly acknowledged in the text.

LONDON, 1913.

21089

AUTHORS' PREFACE

TO

THE FIRST EDITION.

THE subject of Surgery has now become so extensive that any work attempting to deal with it in an exhaustive manner must necessarily be so large and unwieldy as to be suitable only for purposes of reference, or for the use of those who devote themselves exclusively to its practice. In any text-book of convenient size the information given in certain branches of the subject must therefore be considerably condensed, and, as the first essential for the beginner is to have the fullest knowledge of the nature and characters of the diseases that he has to study, special stress is usually laid upon pathology, symptomatology, and diagnosis. For the practitioner, on the other hand, who is already acquainted with these points, the great essential is full and detailed information as to the best methods of treatment.

We have ourselves frequently experienced the want of detailed information, especially as regards the after-treatment of our cases, and have had to learn the best methods of procedure from experience. Nothing can of course replace experience, but it is often of the greatest advantage to have a detailed record of that of others upon which to base one's work. It is this want that the present work is intended to supply. We have tried to put ourselves in the place of those who have to treat a given case for the first time, and we have endeavoured to supply them with details as to treatment from the commencement to the termination of the illness. We have assumed that the reader is familiar with the nature and diagnosis of the disease, and we only refer to the pathology and symptoms in so far as it is necessary to render intelligible the principles on which the treatment is based, and the various stages of the disease to which each particular method is applicable.

We have purposely avoided attempting to give anything like a complete summary of the various methods of treatment that have from time

to time been proposed: to do so would merely confuse the reader. Only those plans are described which our experience has led us to believe are the best, but with regard to these we have endeavoured to state exactly and in detail what we ourselves should do under given circumstances. In some cases no doubt several methods of treatment are of equal value, and while we have discussed at length that which we have ourselves been led to adopt, we have referred shortly to the others.

We have not mentioned all the exceptional conditions that may be met with, but we have endeavoured to include all the circumstances with which the surgeon is most commonly called upon to deal. The task has been one of some difficulty, the more so as we have had, to a certain extent, to break new ground. This must serve as our excuse for the many shortcomings in the work.

LONDON, *April*, 1899.

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DIVISION I.

THE SURGICAL AFFECTIONS OF THE JAWS AND TONGUE.

SECTION I.—AFFECTIONS OF THE JAWS.

CHAPTER I.

FRACTURES OF THE JAWS.

FRACTURE OF THE UPPER JAW.

Fractures of the maxilla are nearly always due to violence applied directly to it, although in some cases the fracture may extend from the skull.

VARIETIES.—*Fracture of the alveolar margin* is not uncommon; it may be produced by severe blows, such as a kick from a horse, and may lead to detachment of the entire alveolus together with the hard palate. In other cases the fracture is limited to a small portion of the alveolar border, as sometimes happens after the extraction of teeth. *The nasal process* may also be fractured by direct violence, and is often accompanied by injury to the lachrymal sac or nasal duct; emphysema is common in connection with it. *Fracture of the anterior wall of the antrum* may be due to blows, or to stabs or bullet wounds; in the latter case the fracture is compound. *Fractures of the palatal process alone* are very rare, and are generally the result of gunshot wounds or direct blows, such as bayonet wounds. Extensive *fracture of the whole bone* or of both bones together is usually only part of some very serious injury, being generally associated with fracture of the base of the skull.

When the fracture is compound and opens either into the mouth or upon the cheek, there may be free hæmorrhage from rupture of the infra-orbital artery; associated with this there is often anæsthesia of the lip and the adjacent side of the nose due to injury to the infra-orbital nerve.

COMPLICATIONS.—The complications of this fracture are: epiphora and emphysema from damage to the lachrymal sac and nasal duct; anæsthesia of the soft parts from injury to the infra-orbital nerve; and hæmorrhage from the infra-orbital or some other artery. The case may also be complicated by fracture of the base of the skull and injury to the brain, while in gunshot wounds there may be a foreign body lodged in the bone or lying loose in the antrum, and this will require removal.

TREATMENT.—It is most important to reduce any deformity present, both from the point of view of the patient's appearance and also because mastication may be seriously interfered with unless the fragments are accurately replaced. Reduction of the deformity may be effected by manipulation under a general anæsthetic.

The most important deformity requiring remedy is *displacement of the alveolar border*, particularly when the whole of the latter is detached and its position relative to the teeth in the lower jaw is altered. After the alveolar border has been brought into position, it must be kept in place either by binding the two jaws together by bandages passing under the chin and over the top of the head, or by introducing a moulded splint between the teeth of the upper and lower jaws on both sides.

When the fracture of the alveolus is only partial, the replaced portion of bone may be held in position by securing the teeth in the fractured portion to the adjacent sound ones by means of a wire splint, such as Hammond's (see p. 5). Union takes place rapidly in these cases, and the apparatus may be discarded in about three weeks. When the fracture traverses other portions of the bone, it is unnecessary to apply any splint after reduction. *When the nasal process has been fractured*, reduction must be effected by instruments introduced into the nose, and as this fracture is usually complicated by fracture of the nasal bones, the after-treatment is similar to that described in Vol. III. p. 456.

When the anterior surface of the bone has been crushed or the orbital margin has been displaced, it may be necessary to make a small incision, introduce a raspatory beneath the fragments, and lever them into position. When this has been done, the bones usually retain their place; if not, they may be fixed by one of the fixation methods suitable for fractures (see Vol. II. p. 305). It must be remembered, however, that the fragments are usually so extensively comminuted that the chance of replacing them accurately is comparatively small, and that necrosis may occur if they are much comminuted. Any operation undertaken with

the view of restoring them to position must be done through the cheek, and it will become a question whether the deformity caused by the scar will be less than that due to the displacement. If incisions are made for this purpose, they should follow the natural wrinkles of the face as accurately as possible, and all the precautions recommended for minimising the scar mentioned in Vol. I. p. 136 should be adopted.

The *prognosis* is good when the fracture is simple; when it is compound, suppuration occasionally occurs at the point of communication with the mouth, and necrosis may take place, although this is comparatively rare. Should suppuration occur, the area from which the pus is coming should be drained, usually by a tube introduced from the mouth; if the antrum is involved, it should be syringed out frequently with sanitas, Condy's fluid or boric lotion, an opening being made into the inferior meatus of the nose if necessary. Any necrosed bone must be removed as soon as it is loose, which will generally be in from three to five weeks.

Hæmorrhage from the infra-orbital artery sometimes gives rise to considerable trouble, but if the skin is unbroken, the application of an ice-bag to the cheek will generally control it. If a wound is present, the bleeding point should be sought for and secured if possible. If the vessel cannot be tied, the wound should be plugged firmly with strips of cyanide gauze. Sometimes the vessel retracts within the bony canal, and the latter must either be opened up or the orifice plugged with Horsley's wax (see Vol. III. p. 376); the objection to the latter procedure is that the wax must also exert pressure on the infra-orbital nerve. Ligature of the external carotid artery has been employed to check the hæmorrhage, but this is not satisfactory, and if the bleeding is severe, it is better to open up the infra-orbital canal sufficiently to secure the vessel.

FRACTURE OF THE MALAR BONE.

This fracture is extremely rare and is practically always associated with fracture of other bones of the face, especially the adjacent portions of the maxilla. It usually results from severe direct violence which drives the bone downwards and backwards, and forces in the anterior wall of the antrum. Fracture of the orbital plate of the superior maxilla may be produced at the same time if the blow is applied more horizontally.

TREATMENT.—An attempt should be made to remedy the displacement by introducing the finger into the mouth and passing it up between the cheek and the upper jaw; if this fails, a small transverse incision may be made anterior to the masseter muscle and a raspatory introduced beneath the bone so as to lever it into position.

FRACTURE OF THE ZYGOMATIC ARCH.

This rare injury is usually the result of direct violence, and is often associated with fracture of the malar bone. When the fracture is due to direct violence, the fragments are generally depressed; when it occurs in connection with fracture of the malar bone, the fractured ends are displaced somewhat outwards.

TREATMENT.—The fragments should be brought into position, otherwise the movements of the lower jaw may be interfered with. Reposition may be attempted first by manipulation from the outside or with the finger in the mouth, but if it cannot be effected satisfactorily, a horizontal incision should be made over the zygoma, the fracture exposed, and the bones drilled and secured by plates or silver wire.

FRACTURE OF THE LOWER JAW.

Fracture of the lower jaw is generally due to direct violence, the bone being fractured opposite the point struck, but not uncommonly the violence is indirect, the bone breaking on the other side. When the angles of the jaw are pressed together forcibly, the fracture often occurs in the vicinity of the symphysis.

VARIETIES.—The most common seat of *fracture of the ramus* is in the neighbourhood of the canine teeth, and the fracture may be unilateral or bilateral; when it is bilateral, the fracture on one side may occur opposite the canine tooth, and on the other just in front of the masseter; in some cases the fracture occurs opposite the canine tooth on both sides, and the central portion of the jaw is separated. *Fracture through the symphysis* itself is of great rarity. *Fracture about the angle* of the jaw is fairly common and is generally due to direct violence; here the fracture is generally behind the last molar tooth. *Fracture of the condyle* is very rare and is only produced either by direct violence, such as gunshot wounds, or by severe blows upon the chin driving it upwards and backwards, so that the condyle is driven against the base of the skull and fracture occurs through its neck; the condyle may even be driven through the base of the skull. *Fracture of the coronoid process* is still more rare owing to the protected position of this part of the bone; it is usually only met with in military surgery.

As a rule fractures of the lower jaw are compound, as there is nearly always laceration of the mucous membrane over the bone; this is practically invariably the case when the bone is broken in its anterior half. When fracture occurs behind the last molar tooth, however, it is not necessarily compound.

The *displacement* of the fragments varies according to the situation of the fracture. *When the fracture is through the body of the bone on one*

side only, there is very slight displacement of the larger fragment, which however, may be drawn somewhat inwards; the smaller fragment is also drawn a little inwards and may be tilted upwards in front. *When the fracture is bilateral* in the usual situation, the middle fragment is pulled downwards and backwards by the muscles passing from the lower jaw to the hyoid bone, while the posterior fragments on the two sides are displaced inwards and drawn upwards. *When the fracture occurs through the angle of the jaw*, the displacement is usually only slight, the posterior fragment being drawn somewhat inwards by the action of the pterygoid muscles.

The chief *complications* of fracture of the lower jaw are :—

1. *Abscess*, which is perhaps the commonest complication. A large number of cases are complicated with suppuration at some period, and in a few cases there may be a large abscess and even more or less extensive necrosis. Occasionally, but very rarely, septicæmia may follow.

2. *Dental Neuralgia and loosening of the teeth.*—In nearly all fractures of the jaw in which the fracture is situated behind the mental foramen, severe toothache is complained of at first. Sometimes this is due to partial tearing of the inferior dental nerve as it lies in its canal; more commonly, it is due to stretching of the nerve by the separation of the fragments. The neuralgia disappears, as a rule, when the fracture is reduced and the tension removed. The teeth adjacent to the fracture are generally loose, so that they could be removed with the fingers, but this should on no account be done, as they will probably become firmly fixed in their sockets in the course of a few days; if partially displaced, they should be replaced and secured to the sound teeth by fine silver wire.

3. *Cerebral Injury.*—This rare complication generally results from severe jarring transmitted through the condyles to the base of the brain as the result of an upward blow causing fracture of the jaw. There may be hæmorrhage from the ear when the condyle is driven back against the auditory canal.

4. *Ununited Fracture.*—This is uncommon and generally only occurs after necrosis about the seat of fracture, or as the result of a loose tooth becoming impacted between the fragments.

5. *Hæmorrhage.*—Severe hæmorrhage has been known to occur from rupture of the inferior dental vessels and has actually proved fatal.

TREATMENT.—**Of the Fracture.**—The treatment of fracture of the lower jaw varies according as the seat of fracture is anterior to the last molar tooth or behind it.

(*a*) *Fractures anterior to the last Molar Tooth.*—In all these cases, the best apparatus, whenever it is possible to use it, is *Hammond's wire splint* (see Fig. 1). It is comfortable to the patient, secures perfect apposition of the fragments and perfect immobility during consolidation of the fracture, and it enables the jaw to be used almost from the first. The

following is the method of application—it is well to get an expert dentist to fix it.

If the fracture is situated at all far back, it is necessary, in the first place, to take a mould of the teeth in the lower jaw while the fragments are temporarily replaced in position ; the splint can then be properly fashioned before adjusting it. If it is necessary to take a mould, this is best done under an anæsthetic in the manner usually adopted by dentists, while the fragments are held firmly in their proper position by the surgeon. A cast is taken from the mould in plaster of Paris and upon this the wire frame is modelled. If, however, the fracture is near the canine tooth, there will be plenty of room for the necessary manipulations, and a mould need not be taken. The splint consists of a frame of fairly stout iron wire, plated or nickelled, which is applied around the necks of two or more sound teeth on each side of the fracture immediately above the mucous membrane of the gum ; it is usual to pass the wire between the third and fourth teeth from the fracture on each side. The wire is then made to fit accurately against the neck of each tooth embraced in the splint ; the ends are brought together, twisted, cut short, and bent up out of the way, so as not to irritate the mucous membrane of the lip. The stout wire framework thus moulded round the teeth is secured in place by binding its two sides with fine silver wire introduced between each tooth (see Fig. 1, *c*). The splint is thus divided into a series of compartments, each of which is occupied by a tooth. The fractured ends are held firmly in apposition while the splint is being applied ; when complete, the splint keeps the fracture in position. When there are only a few sound teeth on either side of the fracture, it is wise

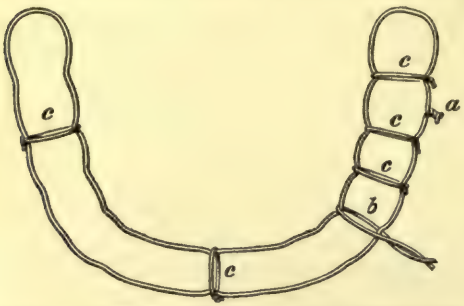


FIG. 1.—HAMMOND'S WIRE SPLINT. The stout wire frame is twisted at *a*, and the ends of the wire cut short and turned down out of the way. Fine binding wires (*b* and *c*) are passed between each tooth so as to fasten the opposite sides of the frame together and form a series of compartments, each containing a tooth.

FIG. 2.—KINGSLEY'S SPLINT. The inter-dental portion fits over the teeth in the lower jaw, to which it has been moulded.

to apply a jaw bandage for the first week in addition to the wire splint.

It is obvious that this splint cannot be used when the jaw is edentulous or when the teeth on one side of the fracture are too few or so loose that its application would pull them out of their sockets. For these cases the splint usually known as *Gunning's* is useful. It consists of two troughs of gutta-percha or some dental composition, moulded to a cast of all the teeth in both jaws; the upper trough receives the teeth of the upper jaw, the lower those of the lower jaw. Between the upper and lower halves of the splint, small props are placed which separate the two portions, so as to leave an interval through which the tube of a feeder can be introduced. The fracture is reduced, and the splint is fitted over the alveolar margins of the upper and lower jaws and kept in position by a firmly applied jaw bandage (*vide infra*).

FIG. 3.—KINGSLEY'S SPLINT APPLIED. The inter-dental portion seen in the preceding figure is kept in place by the bandages passing below the chin and around the neck.

Another splint which is useful, especially if some of the teeth are present, is *Kingsley's* (see Fig. 2) or some modification of it; this is cleaner and more comfortable than Gunning's, and consists of a moulded vulcanite splint which fits over the teeth of the mandible only. At the level of the angle of the mouth on each side, a bar of metal is attached to the splint and projects from each angle of the mouth. These bars are curved somewhat backwards, and are employed to carry a bandage which passes from one to the other beneath the chin so as to press up the jaw firmly into the splint (see Fig. 3). With this splint, as with Hammond's, a certain amount of movement of the jaw can be effected.

When Hammond's or Kingsley's splint has been employed, semi-solid food, such as bread and milk, custard or rice pudding, may be administered after the first week; when Gunning's splint has been used, liquid food must be given until the splint is removed, which will be in about three weeks. In no case should solid food be allowed until four or five weeks have elapsed from the time of the accident. Hammond's splint

need not be removed until the sixth or seventh week ; it lies comfortably around the necks of the teeth and causes no inconvenience if the hygiene of the mouth is duly attended to. It is removed by cutting the main wire opposite each tooth. In all cases, free and frequent irrigation of the mouth with sanitas or boric lotion will be necessary.

(*b*) *Fractures situated behind the last Molar.*—In these cases the lower jaw must be kept closely applied to the upper while the fracture consolidates. This is done by a *jaw bandage* which is made from a strip of calico three inches wide and a yard long (see Fig. 4). A small slit is cut in the centre of this for the reception of the chin, and a four-tailed bandage is then made by splitting up each end to within a couple of inches of the central slit. When applying the bandage, the point of the chin should lie in the central orifice. The upper limb of the bandage is carried horizontally backwards, and the ends are knotted together beneath the external occipital protuberance, while its lower limbs are carried vertically upwards and knotted over the vertex in front of the bregma ; the ends of the vertical and horizontal limbs are then tied together so as to prevent the anterior strips from slipping forward.

FIG. 4.—JAW BANDAGE. The lower limb of the bandage should be tied immediately below the external occipital protuberance.

Before applying the bandage, attempts should be made by manipulation to entangle the broken surfaces so that the bandage simply has to keep the parts at rest after they are placed in position. In some cases a *moulded gutta-percha splint* is applied to the chin inside the bandage, but as a rule this is a source of annoyance and is of little advantage, except when the patient is restless or delirious. The saliva often dribbles away in these cases and soils the bandage rapidly, so that it requires changing frequently. When there are no teeth in the posterior part of the jaw, a modification of Gunning's splint may sometimes be modelled upon the alveolar margins so as to keep the jaws in position when fixed by the bandage, spaces being left for feeding.

The patient should be kept on a liquid diet, administered by means

of a feeder to which an india-rubber tube is attached. The tube can be passed through the space which always exists behind the last molar teeth on the sound side, and the patient can thus be fed without disturbing the bandage. At the end of three weeks the bandage may be discontinued and soft food may be taken. Solid food requiring mastication should be interdicted until the end of the fifth week when the union is fairly firm. The patient need not be confined to bed. A mouth-wash of sanitas or chlorate of potash should be used and is often very comforting. The patient can suck it in with the lips or it can be poured in through a tube behind the last molar teeth, and then ejected after the mouth has been rinsed out.

There are numerous other methods of treating fractures of the lower jaw, but those described above are the ones most generally applicable. *Fixation of the fragments by wires or plates* is rarely called for, but may be necessary when it is impossible to secure proper co-aptation by other means, as, for example, when there is a double fracture of the jaw. The great drawback to wiring is that the fracture is almost always compound and septic, and the operation may be complicated by suppuration about the fracture followed by necrosis and possibly want of union. Hence it should not be employed unless absolutely called for by the failure of other methods. If, however, the proper alignment of the teeth cannot be maintained by any other means, then it is quite necessary to wire or plate the fragments, because proper mastication will be interfered with permanently if there is any great defect in this respect. Wiring may also be useful in fractures at the angle when there is marked displacement of the posterior fragment; in this situation the operation can be carried out without opening into the mouth. Particulars of the operation are given on p. 10.

(*c*) *Fracture of the Condyle.*—Fracture of the condyle often leads to stiffness of the jaw and pain on mastication. It seems almost hopeless to expect good union with any mechanical appliance, and the joint almost invariably becomes stiff from the adhesions following the fracture. The methods of treatment which suggest themselves are to cut down and wire the fragments, to commence movement at once with the view of obtaining a false joint, or to excise the condyle in the manner described in speaking of anchylosis of the jaw (see p. 17); of these, excision of the condyle followed by early movement is probably best.

(*d*) *Fracture of the Coronoid process.*—This is a rare injury which is practically always compound, and is generally the result of gunshot wounds. The fracture may be comminuted, and the fragment, to which the temporal muscle is attached, may be drawn upwards so that it does not unite with the jaw. In these cases the movement may be seriously interfered with, owing to the loss of the connection between the temporal muscle and the jaw.

The wound must be purified and then enlarged, should this be

necessary, so as to expose the seat of fracture. If the coronoid process is comminuted, or if the detached portion is small and a portion of the temporal muscle still remains attached to the jaw, the simplest plan is to remove the fragment. On the other hand, if there is a single large fragment and the wound is clean, it will be best to wire the fragment back into place. In enlarging the wound, the direction of the branches of the facial nerve should be borne in mind and also the position of Stenson's duct, which crosses the masseter parallel to and about a finger's breadth below the zygoma. The infra-orbital branch of the facial nerve lies just above and almost parallel to the duct, the temporal branch runs up almost vertically in front of the ear, while the malar branch occupies a position intermediate between the two. The incision should be transverse or slightly oblique downwards and backwards. After the operation a jaw bandage should be applied, and, when the fragment has been wired in place, the patient may move his jaw in the course of three or four days; when the fragment has been removed altogether, active and passive motion should be begun at once. Early movement of the jaw is of great importance because adhesions are very difficult to overcome if they are allowed to form, and may lead to some degree of closure of the jaws.

Of Complications.—*When there is an abscess in connection with the fracture,* it should be opened early and drained freely; it is essential to open the abscess from the outside, otherwise pus collects at the most dependent part of the cavity, keeps up the inflammation, and may lead to necrosis.

Septicæmia is very rare; its treatment is discussed in Vol. I. p. 189.

Persistent dental neuralgia is of rare occurrence. It usually subsides as soon as the fracture is properly reduced, but it may recur in a very severe form as the result of pressure upon the nerve by the callus thrown out during the consolidation of the fracture. If this be the case, the nerve must either be divided at the dental foramen or an operation for removal of the callus must be undertaken; in the latter, it is by no means easy to find and free the nerve, whereas division of the inferior dental nerve (see Vol. III. p. 478) at an early period will stop the trouble.

Hæmorrhage will very rarely require special treatment. If it is profuse and persists in spite of the free use of peroxide of hydrogen (10 vols.) or adrenalin chloride (1 in 1000), the surgeon will have to choose between exposing the seat of fracture and plugging the inferior dental canal, or tying the external carotid artery. Probably the latter procedure will be safer on account of the risk of sepsis after an operation upon the fracture.

For *non-union,* the ordinary treatment of ununited fracture must be employed, the edges being refreshed and the bones fixed together (see Vol. II. p. 305). The incision should be made over the lower border of the jaw and the soft parts pulled upwards; division of the mucous membrane should be avoided if possible. The fractured surfaces may

then be refreshed by a chisel, the lower margin of the bone drilled and a silver wire passed through it. Great care must be taken to see that the drill-holes on the opposite sides of the fracture correspond, and it is well to employ a grooved drill, which facilitates the passage of the wire. The alveolar margin may be steadied by a Hammond's splint (see p. 5).

CHAPTER II.

AFFECTIONS OF THE TEMPORO-MANDIBULAR ARTICULATION.

DISLOCATION.

From the point of view of treatment these affections may be divided up into recent dislocations, unreduced dislocations, and subluxation of the inter-articular fibro-cartilages.

RECENT DISLOCATIONS.

Dislocation of the lower jaw may be unilateral or, more commonly, bilateral. It is more frequent in women than in men, and usually results from yawning, laughing, or some other action in which the mouth is widely opened. It may also occur from indirect violence, such as a blow on the chin, especially if this be applied in the downward direction so as to force the mouth open. In the normal movement of opening the mouth the condyles of the lower jaw, accompanied by their inter-articular fibro-cartilages, glide forwards over the eminentiæ articulares, on the summits of which the condyles lie when the jaw is fully open. If the depression of the lower jaw is carried beyond this, the inter-articular fibro-cartilages remain stationary owing to their connection with the bone, while the condyles slip forward in front of the eminentiæ articulares, and becomes fixed there by the contraction of the temporal and masseter muscles. The result is that the mouth cannot be closed, any attempt to shut it being met by contraction of these muscles ; the saliva dribbles away and there is severe pain. Mastication is impossible, and speech is almost unintelligible.

TREATMENT.—In order to reduce a *bilateral dislocation*, each condyle must be pulled downwards from the temporal fossa until it reaches the level of the eminentia articularis ; it is then pushed back into position. Reduction is usually effected without an anæsthetic. The patient sits upright in a chair, with the head supported by an assistant or against

the wall. The surgeon stands in front, and, having wrapped lint round his thumbs, he places one on each side along the upper border of the lower jaw just behind the last molar tooth, the palm of each hand being beneath the symphysis. Steady pressure is then made by the thumbs vertically downwards, while the palms beneath the chin press the latter backwards. As the jaw is felt to yield, the bone is pushed bodily backwards. Stimson has pointed out ('Treatise on Fractures and Dislocations') that the chief obstacles to reduction are the tense external lateral ligaments of the temporo-mandibular articulations, and that the best way to relax them is to depress the chin fully before pushing the bone bodily backwards. As a rule, the condyle slips backwards directly it reaches the eminentia articularis and the mouth closes with a snap; the surgeon's thumbs may be bitten if he is not careful. Hence as soon as the condyle begins to move back, the thumbs should be slipped off the bone into the recess between the cheek and the jaw.

If this procedure fails, the patient should be placed under an anæsthetic, when the dislocation can generally be reduced without difficulty by the same procedure. When reduction is very difficult, a piece of wood bound round with lint should be introduced between the last molar teeth on each side, and the chin should then be forcibly elevated so as to lever down the condyles from the temporal fossa; when the teeth almost meet, the jaw should be pushed forcibly backwards. All cases of recent dislocation can be reduced by one of these methods.

The treatment of *unilateral dislocation* is practially the same as that of the bilateral form. It is well to depress both angles of the jaw, but chiefly the one on the dislocated side; the backward pressure should be made on that side also.

The dislocation is very apt to recur if the patient laughs or opens his mouth too widely, and therefore an elastic jaw bandage should be applied in order to support the chin and, at the same time, allow the patient to open his mouth to some extent and feed himself. After about five days the bandage may be left off during the day, but it should be worn at night for at least another week. There is usually no risk of permanent stiffness, because the patient voluntarily uses his jaw and no massage is necessary. In those cases in which dislocation occurs without any violence there is no stiffness or pain after it has been reduced, and no special after-treatment is necessary.

UNREDUCED DISLOCATIONS.

If a dislocation of the jaw remains unreduced, the condition of the patient is very deplorable, although a certain amount of power of approximating the lips is regained after a time and the dribbling of saliva, which occurs at first, may disappear. A certain amount of lateral mobility may also occur, enabling the patient to masticate

his food. As a rule, however, his condition is so bad that an attempt must be made to improve it.

TREATMENT.—Dislocation of the lower jaw has been successfully reduced even four months after the occurrence of the injury, and, when only six or eight weeks have elapsed, an attempt should certainly be made to reduce it under an anæsthetic by the manipulations described above. Before commencing these manipulations, however, it is well to elevate and depress the jaw a number of times with increasing vigour so as to break down adhesions.

If the surgeon fails to reduce the dislocation by manipulation, the best procedure will be to *excise the temporo-mandibular joints.* This operation gives better results than excision of a wedge-shaped portion of the neck of the condyle with the view of forming a fresh joint. In the latter case, the condyle is out of position and the teeth do not approximate properly, even though movement be restored, and, further, the antero-posterior motion is not regained. After removal of the condyle, however, the ramus of the jaw can be pushed back into proper position and a satisfactory result obtained by keeping up movement, especially if the dislocation has been bilateral and both condyles have been excised. The operation is performed as follows (see Fig. 5) :—

FIG. 5.—EXCISION OF THE TEMPORO-MANDIBULAR ARTICULATION. The figure shows the most suitable incision for the purpose.

A curved incision is made over the articulation with its convexity backwards and upwards, the ends of the incision curving forwards so that the base of the flap thus marked out is over the condyle. The flap is raised, care being taken to avoid division of the upper branches of the facial nerve ; if the incision is deepened from behind forwards, they can be pushed forwards along with the fascia and there is no great risk of dividing them. The temporal artery will probably be cut and should be tied at once ; the cutaneous nerves may be pulled backwards or divided if necessary. The zygoma and the upper part of the masseter are exposed and a portion of the latter muscle is detached from the zygoma from behind forwards until the displaced condyle is exposed. When the condyle has been brought into view, the jaw is depressed by an assistant so as to bring the condyle down from beneath the zygoma ; this can generally be done fairly easily if anchylosis has not taken place.

The neck of the condyle is then divided with a pair of cutting pliers and the loose condyle pulled downwards and dissected out. In removing the condyle care must be taken not to damage the internal maxillary artery, but the chances of this are not so great as when the operation is performed for anchylosis of the jaw, because in the cases under consideration the condyle is carried forwards out of the way of the vessel. If any difficulty is experienced in pulling down the condyle, in order to cut through its neck, Gigli's wire saw may be passed round the neck of the bone (see Vol. III. p. 33) and the latter divided *in situ.*

After the condyles have been removed, the jaw is forcibly depressed and pushed backwards into position; before closing the wound, the jaw should be moved backwards and forwards and up and down so as to tear through any adhesions, and the glenoid cavity should be cleared of any soft material in it. In order to guard against the possibility of anchylosis following the operation, it is well to employ Murphy's method of arthroplasty (see Vol. III. p. 153) covering over the cut surface of the neck of the condyle, with a flap of soft tissues turned in from the masseteric region.

The wound is closed with a continuous suture, and a drainage tube is not required. The jaw should be fixed with an elastic jaw bandage so arranged as to pull it backwards as well as upwards, and it is well to begin passive motion within two or three days after the operation; in some cases an anæsthetic may be necessary at first. All the movements of which the jaw is capable should be carried out, at first daily and subsequently twice a day, for a very considerable time. After a few days the jaw bandage need only be worn at night. The result is very satisfactory when both condyles have been excised; when only one has been removed, the jaw is shorter on one side than on the other and there may be some inequality in the movement of the two sides.

SUBLUXATION OF THE INTER-ARTICULAR FIBRO-CARTILAGE.

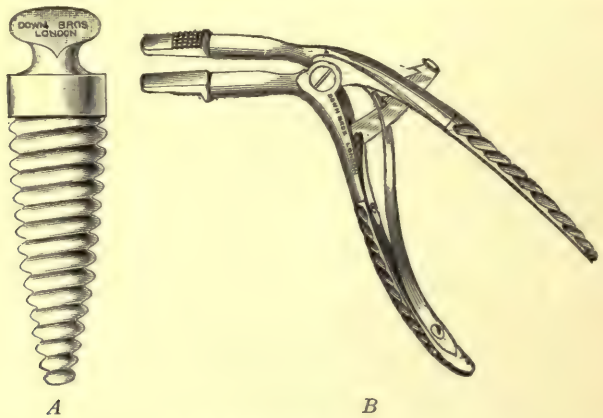
This condition—which is also termed subluxation of the jaw—is not very uncommon. It is supposed to be due to abnormal mobility of the inter-articular fibro-cartilage, which gets out of place when the jaw is opened widely. The result is that the jaw becomes temporarily fixed and the mouth can only be shut by an effort and with a definite clicking sound, which is sometimes accompanied by much pain. Occasionally there may be some effusion into the joint.

TREATMENT.—Treatment is not likely to be of much avail unless there is definite laxity of the ligaments from previous injury or inflammation. In some cases improvement may follow the employment of vigorous counter-irritation applied directly over the articulation. As a rule the trouble passes away after a few weeks or months.

INFLAMMATORY AFFECTIONS.

The temporo-mandibular articulation may be the seat of various inflammatory conditions, which cause considerable trouble from interference with mastication and articulation. Among them may be mentioned: acute rheumatism; gonococcal arthritis, which is fairly frequently met with; suppurative arthritis, resulting from a wound of the joint, from some septic focus in the immediate neighbourhood, or as a part of a general pyæmic condition; osteo-arthritis; and sometimes, though very rarely, tuberculous disease.

TREATMENT.—The treatment of these conditions differs in no essential respect from the treatment of similar affections in other joints.



A *B*

FIG. 6.—GAGS FOR ANCHYLOSIS OF THE JAWS. *A* is the conical screw-gag of boxwood. *B*, the powerful metal form.

It is, however, important to remember that the stiffness which is apt to result from any inflammatory affection of the articulation may cause considerable trouble to the patient subsequently, from impaired mobility and inability to separate the teeth. This is especially apt to occur after rheumatic or gonococcal arthritis. Movements of the jaw should therefore be commenced as soon as the inflammation has passed off, and, if necessary, adhesions should be broken down under an anæsthetic, the administration of which, in cases of closed jaw, however, requires great care. When there is much tendency to contraction, the best plan is to employ some form of gag to keep the teeth apart. A conical boxwood gag or a double wedge provided with a screw arrangement so as gradually to increase the separation between the teeth (see Fig. 6) may be used.

ANCHYLOSIS.

Adhesions are very prone to form after any inflammatory affection of the temporo-mandibular joint, and these may lead to stiffness or complete anchylosis of the joint. The affection may be unilateral, but is commonly bilateral.

TREATMENT.—The treatment depends upon the condition present. So long as the trouble is due to *adhesions*, the usual treatment must be employed. This consists in forcible movements under an anæsthetic, followed by passive movements and the use of a gag worn continuously. If, however, the adhesions have become firm, very little is to be hoped for from this method, and, under such circumstances, the force employed to rupture the adhesions is likely to fracture the neck of the condyle; moreover, the torn adhesions are apt to re-form. Hence, when the adhesions are very firm, the only methods of treatment are to remove the condyle of the jaw and make a false joint, or to divide the neck of the condyle and try to get a false joint.

Excision of the joint is performed through an incision an inch and a half in length along the lower border of the zygoma; it should curve downwards immediately in front of the tragus. The steps of the operation are identical with those mentioned above for excision of the joint for unreduced dislocation, except that the neck of the bone has to be cleared and divided *in situ*, and the head dissected out. Enough bone must be removed to leave a good gap between the neck of the condyle and the eminentia articularis, and Murphy's method of arthroplasty (see Vol. III. p. 153) by turning in a flap of soft parts from the masseteric region should be employed. It is common to have slight facial paralysis after the operation, but this is usually due to stretching of the nerve and is transient. Passive movements, at first under an anæsthetic, should be commenced the day after the operation; these movements will become less painful after a few days, and the use of a screw gag should then be commenced. When the gag is not being used, the mouth should be kept open with a dental prop.

The results are best when the affection is one-sided. Even in bilateral cases, however, satisfactory results may be obtained if the treatment is persevered with for a long time, and it must be especially vigorous if there should be any tendency to re-contraction.

Division of the neck of the condyle is carried out in exactly the same manner up to the stage of removing the head of the bone. Instead of doing so, as large a portion of the neck as possible is removed and soft tissues are turned in between the cut surfaces to prevent subsequent bony union. The after-treatment is movement and massage as in the previous case.

CHAPTER III.

INFLAMMATORY AFFECTIONS OF THE JAWS.

Inflammation of the gums and jaws is most commonly associated with caries of the teeth. It may also occur from the accumulation of tartar around the neck of the teeth, from the action of drugs, such as mercury or phosphorus, from septic infections and aphthous conditions of the mouth, or in connection with specific infective diseases, such as syphilis, tubercle or actinomycosis; it may also be associated with digestive troubles. The inflammation may be limited to the alveolar process or may affect the body of the jaw; it may commence in the periosteum and lead to thickening of the bone, or it may begin in the substance of the bone and end in alveolar abscess or necrosis.

GINGIVITIS.

In inflammation of the gums *from excessive administration of mercury* the treatment is to stop the administration of the drug, to employ antiseptic mouth-washes, and to administer chlorate of potash in ten-grain doses three or four times a day. Chlorate of potash (gr. x ad ℥j) is also an excellent mouth-wash.

An aphthous condition of the mouth is not uncommonly accompanied by a similar affection of the gums; the treatment consists in free purgation, and the employment of antiseptics, such as boro-glyceride, sanitas, or weak Condy's fluid. Glycerinum acidi carbolici diluted to 1 in 40 is an excellent soothing application.

In *secondary syphilis* there is also ulceration of the gums following the formation of mucous patches upon them. The treatment is that of secondary syphilis (see Vol. I. Chap. XI.).

PYORRHŒA ALVEOLARIS.

The most interesting of the inflammations of the gums is that known as pyorrhœa alveolaris; it often escapes recognition or is mistaken for

ulcerated gums in connection with the administration of drugs or some dyspeptic condition. The ulceration, however, is at first limited to the gum in immediate contact with the teeth ; by making pressure on the gum, pus may be pressed up from between it and a tooth. The disease is usually due to septic infection in cases in which there is an accumulation of tartar between the gums and the teeth.

TREATMENT.—All tartar should be removed as a preliminary measure, and every effort made to prevent the pus collecting between the teeth and the gums. Much difference of opinion exists as to the further treatment of this disease. On the one hand, some authorities assert that the use of astringents and antiseptics locally (such as hydrogen peroxide solution [10 vols.] and sulphurous acid, applied carefully so as to clean out the pockets between the gums and the teeth) suffice for a cure, especially if combined with vaccine treatment directed against the organisms present in the pus. On the other hand, it is affirmed that there is little hope of curing a well-established case unless the teeth are extracted. It is certain, however, that extraction does not always result in cure, and neither does the prolonged administration of vaccines made from the organism or organisms present in the mouth to which the patient's opsonic index is found to be low. The treatment should, in any case, be undertaken by a dentist. It is very important that the affection should be taken in hand early ; if neglected, it may lead to general infection, various forms of arthritis, and digestive troubles.

PERIOSTITIS.

The limited thickenings of the jaw which are not due to specific infections such as syphilis or actinomycosis, generally arise in connection with carious teeth, and the swellings to which they give rise are sometimes difficult to diagnose from tumours. There may be suppuration at the base of the tooth, but marked thickening of the jaw may occur without any pus being present.

TREATMENT.—The thickening rapidly disappears on removal of the carious tooth. If neuralgic pain persists, the gum may be painted freely with tincture of iodine.

ALVEOLAR ABSCESS.

The most common inflammatory affection of the jaws is a limited suppurative osteitis, commonly spoken of as alveolar abscess. Alveolar abscess is a suppuration occurring around the fangs of a tooth which is usually carious ; the pus may escape between the neck of the tooth and the jaw, but more often leads to the formation of an abscess cavity in the bone which gradually enlarges as the pus approaches the surface. In the majority of cases it reaches the surface beneath the gum and

leads to what is popularly known as a 'gumboil.' When the fang is long, however, and the abscess more deeply seated in the body of the jaw, the pus generally reaches the surface of the bone lower down, and may lead to adhesion of the cheek to the jaw and to the formation of an abscess on the face—generally near the lower border of the jaw.

An abscess which follows the latter course is sometimes mistaken for a suppurating gland, but when it is opened, a probe will pass upwards into the channel in the bone from which the pus is escaping. In the case of an alveolar abscess in the upper jaw, the pus may make its way into the antrum and cause suppuration there. In the milder forms of alveolar abscess there is no necrosis, but when the inflammation is severe, this may occur and may sometimes be extensive; the severe forms are most frequently met with when the suppuration occurs in connection with an impacted wisdom tooth.

TREATMENT.—Removal of the tooth is essential in most cases, and if the pus has not reached the surface of the bone, this often suffices for the cure of the disease, the pus finding its way through the tooth socket and the abscess cavity gradually closing.

When the pus has made its way externally either through the gum or beneath the skin, it must be evacuated, but healing will seldom occur until the tooth is removed; unless this is done, a sinus, leading through a channel in the bone to the root of the tooth, may persist for a long time. On the other hand, the sinus generally closes very quickly when the tooth is removed. It is very important to prevent the abscess from spreading to the cheek, and therefore, when the cheek is becoming adherent to the jaw, it is well to incise the indurated tissues freely from within the mouth by a vertical incision through the mucous membrane as it is reflected from the gum to the cheek. Pus will usually be found, and if that is the case the opening in the bone leading to the tooth can be identified and enlarged, the tooth removed, and the wound well drained; in most cases the inflammation will subside without extending further into the cheek.

ACUTE NECROSIS.

The extensive and violent inflammations leading to necrosis of portions or the whole of the jaw may be due to a carious tooth, to suppuration around an impacted wisdom tooth, or to fracture of the jaw. These affections usually occur about the angle of the lower jaw; they are not common in the upper jaw. Pus readily forms between the periosteum and the bone and the necrosis may be considerable.

TREATMENT.—The treatment must be carried out on the lines already indicated for acute osteitis generally (see Vol. II. p. 433). The first point is to remove any local cause as quickly as possible; therefore, any carious teeth or an impacted wisdom tooth should be extracted without delay. This is often difficult as the jaws are generally more or

less closed, at first from spasm and subsequently from inflammatory infiltration of the muscles, so that it is extremely difficult or even impossible to open the jaws widely enough to extract an impacted wisdom tooth. Its removal, however, is absolutely essential, and if the mouth cannot be opened widely enough, the mucous membrane over the posterior part of the jaw must be incised, the bone over the tooth cut through with a chisel, and the fang turned out of its bed.

These cases present many difficulties in treatment. The pus is always deep-seated and may give rise to severe constitutional symptoms and much distress in mastication; pyæmia or septic pneumonia is not an infrequent complication. It is impossible to relieve the tension satisfactorily in the early stages by the very free incisions usually employed in cases of acute osteitis elsewhere owing to the danger of wounding the facial vessels and nerve which lie directly over the affected area, and it is often necessary to wait until there is some indication as to where the pus is going to point.

It is essential to obtain free drainage of the pus surrounding the necrosed bone; as long as it does not escape properly the necrosis extends and the patient is liable to general septic infection. In the great majority of cases in which the disease occurs about the angle of the jaw, it is necessary to make an external opening at the most dependent spot. Opening the abscess from the mouth is not enough; the escape of pus is defective, saliva flows into the cavity, decomposition is excessive and the skin is sure to give way over it. It is much better, therefore, to make a suitable external opening. The mucous membrane over the abscess is incised from the mouth, a pair of sinus forceps passed down the outer surface of the bone to the lowest point of the cavity and a suitable incision made through the skin, taking care to avoid branches of the facial nerve; a drainage tube is then pulled into the cavity. The skin incision for this purpose should always be parallel to the lower border of the jaw in the case of the mandible, or in the lines of the natural folds of the cheek in the case of the maxilla. This reduces scarring to a minimum.

The cavity must be washed out frequently until the dead bone is loose; this will usually be the case in six or eight weeks, according to the situation and extent of the necrosis. Here, as elsewhere, the sequestrum gradually becomes enclosed in a bony sheath, so that the bone may be more or less reproduced by the periosteal new growth, even when the greater part of the jaw has become necrosed. It is advisable not to be in a hurry to remove the necrosed bone, provided that the patient keeps well, because it preserves the shape of the jaw and so allows proper reproduction of the bone; if it were removed before sufficient periosteal new formation had occurred, the new jaw would be misshapen.

Removal of the necrosed fragment is usually a comparatively simple operation, and can generally be carried out from the mouth by enlarging the opening in the mucous membrane leading down to the sequestrum and

dividing any bridge of bone which interferes with its easy extraction. It is only rarely that an external opening is required. Care must be taken that all the necrosed bone is removed and that no spicules are left behind. No dressing is necessary, except possibly a temporary plug of iodoform gauze if there is much oozing, but this should not be kept in for more than a few hours, otherwise it will become extremely fœtid. The mouth should be washed out frequently with an antiseptic mouth-wash, such as peroxide of hydrogen (10 vols.), sanitas, or Condy's fluid, and the drainage tube introduced into the cavity from outside should be retained until the sinus closes, which it usually does rapidly. The diet should be liquid or semi-solid at first.

Steps must be taken to counteract the tendency to closure of the jaws that is so often associated with necrosis in the neighbourhood of the ascending ramus, and therefore, when the necrosed fragment has been removed, the mouth should be kept open by a wedge placed between the teeth on the sound side ; provided that the new bone is so firm that it will not break, repeated active and passive movements should also be carried out. The patient should sleep with the wedge in the mouth, so secured that it cannot slip.

TUBERCULOUS DISEASE.

This affection is not common and chiefly occurs in the upper jaw, especially about the orbital margin and in the neighbourhood of the malar bone ; it may also be met with in the lower jaw in the neighbourhood of the angle. The treatment is similar to that of tuberculous disease of bone elsewhere (see Vol. II. p. 453). When the disease is superficial, the tuberculous focus should be removed quite early, and in all cases the incisions should be so planned as to injure the parts and scar the face as little as possible.

PHOSPHORUS NECROSIS.

This condition is fully described in Vol. II. p. 450.

ACTINOMYCOSIS.

This affection is dealt with in Vol. II. p. 458, but certain of its features are best marked in connection with the lower jaw, and require notice here.

The lower jaw is a common seat of actinomycosis which leads to the formation of a slow growing tumour of variable size, which may be mistaken for sarcoma. The source of infection is often a carious tooth or an ulcer of the gum. The swelling is generally near the angle of the jaw where it commences as an indurated mass, the skin over which has a characteristic bluish-red appearance. Small yellowish pustules soon

appear on the surface, burst, and discharge the characteristic yellow granular débris. There is often widespread induration in the masseteric region and in the neck.

TREATMENT.—Large doses of iodide of potassium (gr. xx.–xxx. three times a day) are most valuable. In addition, all the diseased tissue should be scraped away freely after sinuses have been slit up to facilitate access. It is a good thing to expose the affected area to the X-rays during the course of the drug treatment. The scraping may be accompanied by very free oozing that may require firm pressure for its arrest.

CHAPTER IV.

TUMOURS OF THE JAWS.

CYSTS.

It is not uncommon to find cysts in the jaws which originate in connection with the teeth. These cysts are of three kinds: Dentigerous cysts, simple dental cysts, and multilocular cysts.

DENTIGEROUS CYSTS.

These cysts are also known as Follicular odontomes. They contain a clear, somewhat mucoid fluid; they are unilocular and have either a well-developed tooth or the rudiments of a tooth in their interior. They may occur in either jaw and usually develop in connection with the permanent teeth; they have been found, however, in connection with the temporary teeth. They generally appear between seven and thirty years of age. They increase slowly, and gradually expand and thin the bone over them, so that in advanced cases there is the sensation known as 'eggshell crackling' on pressure; indeed, the bone may be actually destroyed and fluctuation may be present. In the upper jaw the cysts extend upwards and bulge into the antrum, and they also dilate the bone outwards so as to form a prominence on the cheek. They may become infected and undergo suppuration.

TREATMENT.—The treatment consists in free removal of the cyst wall which, in most cases, can be carried out from the mouth. The mucous membrane is reflected from the swelling, the outer wall of the cyst cut away with scissors or cutting-pliers, the lining membrane of the cavity scraped out and any tooth in the interior removed. In addition to scraping the cavity so as to get rid of the lining membrane of the cyst, it is well to gouge its surface thoroughly and afterwards to sponge it with undiluted carbolic acid; it should be stuffed lightly with strips of cyanide gauze

for the first twelve hours and then left freely open. In no case is it necessary to excise a portion of the jaw, but any expanded portion should be shaved down with a gouge or chisel to avoid deformity. An antiseptic mouth-wash of sanitas or boro-glyceride should be used frequently.

DENTAL CYSTS.

Simple cysts not containing a tooth also occur in the jaws and probably develop in connection with the root rather than with the crown of the tooth, as is the case with the dentigerous cysts. They nearly always occur in connection with a carious tooth, often with a fang that has been left behind after the rest of the tooth has been extracted. They are said to be due to the irritation of some fœtal remains of the dental organ, which gives rise to the formation of a cyst. They are more frequent in the upper jaw than in the lower, and are connected with the incisors or canines more often than with the molars. They may occur not only in young adults, but also at a later period of life. The further history of the cyst is the same as that of a dentigerous cyst.

TREATMENT.—This is very similar to that of a dentigerous cyst. The tooth in connection with the cyst—or the broken fang if there is one—must be extracted, and the lining membrane of the cyst must be thoroughly removed. The wall of the latter should then be cut away so that the mucous membrane can fall on to the opposite wall.

MULTILOCULAR CYSTS.

These cysts are also known as Epithelial odontomes and Fibro-cystic disease of the jaw; they are most commonly found in the lower jaw. They may involve the greater part of the ramus and lead to the formation of irregular nodular tumours which sometimes fluctuate in parts. On section there are numerous cysts of varying size which communicate with one another and which, in all probability, are developed from the remains of the dental organ. These multilocular cystic tumours may occur at any age. Their growth is very slow, but may become more rapid from the development of endothelioma or epithelioma in the walls of the cavities.

A considerable number of the so-called multilocular cystic tumours of the lower jaw are in reality cysts developed in tumours, especially myeloid sarcomata.

TREATMENT.—The complete removal of the mass is very essential and, in a good many cases, this can only be done by excising the portion of the jaw involved. The methods for partial excision of the lower jaw will be found on p. 48.

Great care must be taken to make sure that the excision goes wide of the disease. Recurrence is not infrequent after operations for this

affection, and may be due either to the fact that malignant disease has supervened or that the original removal was not free enough. If malignant

FIG. 7.—FIBRO-CYSTIC DISEASE OF THE MANDIBLE. In the case from which this drawing was made the growth extended so widely into the neck that it was difficult to expose the external carotid artery in order to pass a temporary ligature round it.

disease has supervened, the case must be treated as one of malignant disease of the lower jaw (see p. 45).

SIMPLE GROWTHS.

Various simple tumours, such as exostoses, fibromata, chondromata, and myxomata occur in connection with the jaws. They are either connected with the surface of the bones or arise in their interior; they are, perhaps, more frequent in the lower jaw than in the upper. Their treatment presents no feature of special importance.

EPULIS.

The term 'epulis' is a general term applied to growths of different histological characters which spring from the margin of the gum. In

some cases these tumours are of inflammatory origin, in others they are new growths, such as fibromata, sarcomata (myeloid, round- or spindle-celled) or, more rarely, angiomata. The inflammatory varieties probably arise in connection with the peri-odontal membrane, usually as a result of dental caries. They spring from the gum at the side of a tooth, and grow either outwards or inwards between the teeth ; as they increase, they may cause deviation of the teeth by their pressure. If they reach any considerable size they may ulcerate and bleed freely.

TREATMENT.—The tooth in connection with which the growth arises must always be removed ; in addition, the growth and the adjacent muco-periosteum must be taken away. When the swelling is not due to a tumour, recurrence seldom takes place if this has been done efficiently.

If the growth is evidently a new growth, a considerable portion of the bone must also be removed ; the amount depends on the extent and nature of the tumour. In a small myeloid growth the extraction of a tooth on each side, and the division of the muco-periosteum over the alveolus by a V-shaped cut with its apex well below the tumour, allows a wedge of bone to be removed along with the tumour growing from it, and will generally suffice.

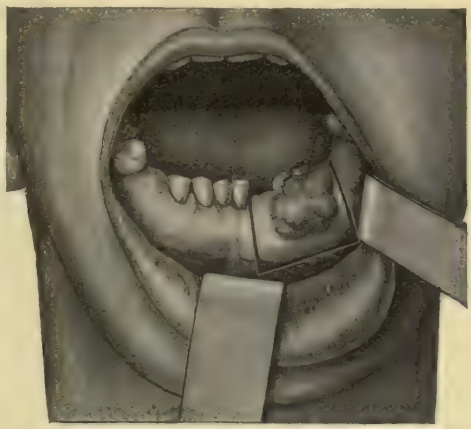


FIG. 8.—REMOVAL OF AN EPULIS OF THE LOWER JAW. The incision in the bone corresponds to that shown on the mucous membrane.

When recurrence takes place, or when the tumour is malignant, a quadrilateral portion of the jaw at the least must be taken away after removing the necessary teeth. To do this, a vertical saw-cut is made through the bone on each side of the growth, and these are connected transversely by Gigli's wire saw (see Fig. 8) so as to remove the bone involved and leave the lower part of the jaw intact. The hæmorrhage is usually easily stopped by pressure ; if it is severe, the bleeding point may be touched with the actual cautery or the canal in the bone may be plugged with Horsley's wax (see Vol. III. p. 376).

In recurrent cases of myeloid epulis and in all cases of round- or spindle-celled sarcomata, it is wiser to remove the affected portion of the jaw completely and well beyond the growth. In every case in which an operation is performed upon the jaw, the most scrupulous attention must be paid beforehand to the hygiene of the mouth (see p. 31). Neglect of this precaution may have very serious results.

MYELOID SARCOMA.

The general characters and appropriate treatment of this form of growth have been dealt with in connection both with tumours in general (see Vol. I.) and with neoplasms of bone (see Vol. II.). As, however, it affects the jaws fairly frequently, and as its treatment there presents some special features of importance, it requires further consideration here.

The growth is more common in the mandible than in the maxilla. It may occur as a small nodular outgrowth from the margin of the gum —a variety of the so-called 'epulis'—or it may be a typical endosteal tumour, expanding the bone and giving rise to the characteristic 'egg-shell crackling.' Its malignancy varies, but the majority of cases are of the semi-benign type usually associated with the name 'myeloma.'

TREATMENT.—*When the tumour assumes the form of an epulis*, its treatment will follow the lines appropriate for the treatment of that affection, but the operation must be radical. Tne tooth nearest the tumour on each side should first be extracted, and vertical incisions must be made through the muco-periosteum of the gum, well wide of the tumour on each side; these are joined by a horizontal cut at some distance below the growth, and the portion of the jaw thus marked out is removed in the manner described on p. 27. The portion of bone taken away should include the whole depth of the tooth socket at least.

When the tumour is endosteal, it will suffice, in the first instance at any rate, to scrape the tumour out of the bone with a sharp spoon and a gouge, and then apply undiluted carbolic acid freely to the wall of the cavity. The question then arises as to the best way of dealing with the expanded shell of bone. This varies somewhat, according as the growth is in the mandible or in the maxilla. *In the mandible* all the expanded shell of bone should be cut away with a chisel after reflecting and preserving the muco-periosteum on both sides. The inferior margin of the bone should be preserved in every case if possible, so as to avoid deformity. The reflected periosteum is then brought over the cut surface of the bone by catgut stitches. *In the maxilla*, it is not always necessary to remove the expanded bone as recommended above. Deformity can be avoided by pressing back the thin shell of bone after the tumour has been shelled out until it is flush with the normal level of the bone. This will probably cause partial fracture, but that is of little consequence as the drainage is free.

No dressing is required. Frequent syringing with hydrogen peroxide (10 vols.), sanitas or Condy's fluid, should be employed, and care taken to see that food does not lodge in any cavity left. Should it do so, it must be dislodged by a jet of water.

When a myeloma has recurred after removal, it must be looked upon as a malignant growth of the jaw, and appropriate treatment adopted (*vide infra*).

MALIGNANT GROWTHS.

The true malignant tumours of the jaws require different treatment, according as they occur in the maxilla or in the mandible.

MALIGNANT TUMOURS OF THE UPPER JAW.

These are usually either carcinomata or sarcomata, but endotheliomata are also met with. The tumours may occur in a variety of situations and give rise to very different appearances. They may grow from the periosteum in front; they may arise in the antrum, in the periosteum or the structures behind the jaw, or they may begin in the nose and the ethmoidal cells, and spread to the jaw secondarily. As a consequence, the symptoms and appearances differ widely in individual cases, as do also the treatment and the extent of the operation.

SYMPTOMS.—*When the tumour is on the anterior surface of the jaw*—in which case it usually begins near the malar process or is a primary affection of the malar bone extending on to the jaw—the main feature is swelling in the cheek with speedy involvement of the skin, but without blocking of the nose, affection of the hard palate, or elevation of the eyeball. The absence of these last characters distinguishes it from a tumour that has commenced in the antrum and burst through the anterior wall.

When the tumour commences in the interior of the antrum, it gradually fills that cavity and distends its walls. After a time it bulges inwards, leads to blocking of the nostril on the affected side, and often to epiphora from pressure on the nasal duct. It presses up the orbital plate of the maxilla and leads to elevation of the eyeball; it affects the hard palate, causing a swelling in the roof of the mouth, and it also bulges into the cheek. When the tumour commences in the wall of the antrum, it may remain limited to one part of the cavity in the early stages. Thus it may chiefly affect the floor and destroy the hard palate, while the orbital plate is unaffected. In other cases it may arise in connection with the roof; the eyeball will then be displaced, and the disease will extend to the ethmoidal cells, while the palate remains intact. When the disease has spread to the ethmoidal cells, the eyeball is pushed outwards in addition to being elevated.

When the tumour commences at the back of the jaw or in the spheno- or pterygo-maxillary fossa, and only affects the jaw secondarily, the nostril may remain patent, there will be no epiphora and no bulging downwards of the palate, and the swelling in the cheek is not usually particularly marked. Among the early symptoms in these cases is protrusion of the eyeball from the extension of the growth into the orbit; before long a swelling forms in the temporal fossa.

When the tumour commences in the ethmoidal cells, one of the earliest

symptoms is displacement of the eye outwards, soon followed by a swelling at the root of the nose and the inner side of the orbit. The disease spreads on to the maxilla and into the upper part of the antrum.

The origin, situation, and extent of the growth are of great importance in determining the operations that may be required, and still more in connection with the question of the advisability of operating at all. When the tumour is growing rapidly and the eyeball is displaced outwards, it is evident that the ethmoidal cells, and probably also the base of the skull, are involved in the disease, and all hope of extirpating it is, as a rule, out of the question. When, on the other hand, the tumour is of slow growth, the fact that the eyeball is thus displaced does not render the case inoperable, because the tumour may fill up the ethmoidal cells without involving the bones, and when the mucous membrane is peeled out the growth comes away with it. When the eyeball is pushed forwards or inwards, or both, the chances of success are extremely slight, and, as a rule, it is not advisable to interfere ; the tumour is evidently growing in the spheno-maxillary fossa and probably affects the sphenoidal sinus and the periosteum of the base of the skull.

The cases suitable for operation are those in which the tumour is limited to the antrum or to one of the surfaces of the maxilla, and has not yet extended up into the cells at the base of the skull. Mere elevation of the eyeball is no contra-indication to operation, and when the tumour starts in the malar bone or in front of the jaw, operation is justifiable, even when the growth is extensive.

TREATMENT.—If the general principles governing the removal of malignant growths were applied to the upper jaw, it would mean that the entire maxilla would be removed in all cases of malignant disease. Complete excision of the upper jaw has, however, two great disadvantages. In the first place, the result of removal of the orbital plate of the maxilla is that the eyeball loses its support and drops, so that the eye may look downwards ; the resulting diplopia is permanent and a source of great discomfort. In the second place, the removal of the hard palate and the consequent establishment of a free communication between the mouth and the cavity previously occupied by the maxilla is a considerable inconvenience to the patient. Of these troubles, the most inconvenient is the dropping of the eyeball, and in cases in which the entire floor of the orbit has to be removed, we believe that it is better to enucleate the eye at once. From the point of view of treatment, the cases may be divided into four groups :—

1. Those in which there is an extensive growth filling the antrum and involving practically the whole of its lining membrane.

2. Those in which the disease is either primary in the nose and only makes its way into the antrum secondarily, or is localised to the nasal region of the latter cavity and does not affect the other walls.

3. Those in which the growth is found chiefly or entirely on the alveolar margin and only affects the antrum secondarily, if at all. These are the common cases of epithelioma of the gum and palate.

4. Those commencing on, or near the margin of the orbit. These are often sarcomatous in nature.

For each of these classes a separate operation is applicable. For the first group, complete excision of the upper jaw is necessary ; for the others, the removal may be more partial, so as to obviate the serious disadvantages of the complete operation, while ensuring adequate removal.

1. Of cases involving the whole Antrum.—When the disease is extensive and the whole maxilla is affected, there is no alternative but to remove the entire bone. The quickest and safest method of doing this is by means of the operation devised by Fergusson.

Prior to the performance of any operation on the jaws and about the mouth, great care should be taken to cleanse the mouth and especially the teeth, otherwise serious infection of the wound may occur. The teeth should be cleaned, scaled, stopped, or extracted by a dentist some days before the operation, and the gums and the tongue should be thoroughly cleansed every day with a tooth-brush and a paste or powder containing antiseptics and astringents. A mouth-wash of sanitas or Condy's fluid should be used freely for several days prior to the operation. Some surgeons recommend a preliminary course of treatment with vaccines of any organism found in the patient's mouth, to which his opsonic index is low. Apart from the question of the value of this treatment, it is never advisable to delay the operation for the purpose of carrying it out. As a matter of fact, it is very remarkable how seldom there is any serious septic trouble after this operation.

In performing the operation, the first point to be borne in mind is that blood accumulates in the pharynx, and not only interferes with breathing, but also tends to run into the trachea, and may then either choke the patient, or—if it carries in septic material from the mouth—may lead to septic pneumonia and a fatal result after two or three days. It has been suggested that the anæsthetic should not be pushed deeply, and that the power of swallowing and coughing should be retained, but this is very trying and distracting to the operator, and may seriously interfere with the rapidity and accuracy of the operation. It is therefore necessary both to have the patient completely anæsthetised and to prevent blood passing into the larynx. This can be accomplished by performing a preliminary laryngotomy, and administering the anæsthetic through the tube, while the pharynx is plugged with large marine sponges (see Vol. I. p. 467), or by the intratracheal insufflation method described below.

The anæsthesia may be induced by chloroform, ether, or mixture, but as soon as the laryngotomy tube is introduced, chloroform, given

by means of a Junker's apparatus and tube, is the most convenient, and in this way the face is left free for the operation. The objections to the use of ether in these cases have been largely overcome of late by the introduction of two methods of administration, which, though still on trial, bid fair to become of considerable service. We owe the following paragraphs to the kindness of our colleague, Dr. Silk.

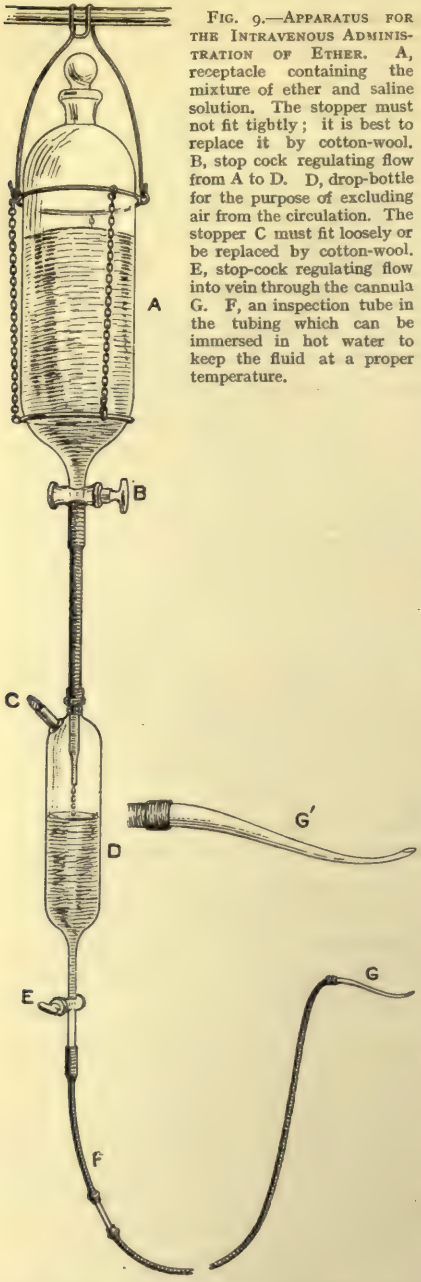


FIG. 9.—APPARATUS FOR THE INTRAVENOUS ADMINISTRATION OF ETHER. A, receptacle containing the mixture of ether and saline solution. The stopper must not fit tightly; it is best to replace it by cotton-wool. B, stop cock regulating flow from A to D. D, drop-bottle for the purpose of excluding air from the circulation. The stopper C must fit loosely or be replaced by cotton-wool. E, stop-cock regulating flow into vein through the cannula G. F, an inspection tube in the tubing which can be immersed in hot water to keep the fluid at a proper temperature.

'*The administration of Ether by the Intravenous Method.*—This plan was first introduced by Burckhardt, and in this country by Rood (*British Medical Journal*, October 21, 1911). Ether is dissolved in isotonic salt solution in the proportion of one ounce of ether to each pint of fluid, and this is gradually introduced into a vein in the arm or leg, in precisely the same way as an ordinary saline injection, and, of course, the same care must be taken that the solution and apparatus are strictly aseptic. Certain special precautions are necessary. The fluid must be warm, but the temperature should not exceed 90° F., otherwise the ether will begin to boil; to prevent the formation of thrombi, the flow must be absolutely continuous, and this can be ensured by the apparatus devised by Rood (see Fig. 9). Until full anæsthesia is obtained, the flow of fluid must be free, but when once narcosis is established (in three to five minutes) the supply may be cut off to a mere dribble. The anæsthesia produced is generally very satisfactory, and capable of the most delicate regulation. Dr. Rood advocates the administration,

about three-quarters of an hour beforehand, of an hypodermic injection of scopolamine, $\frac{1}{100}$ gr.; atropine, $\frac{1}{100}$ gr.; morphine, $\frac{1}{6}$ gr.; and maintains that if this be done, but little more than 1 to 1½ pints of the solution per hour is required. If the preliminary injection be not given, nearly double the quantity of the saline will be necessary.

'*Hedonal* has more recently been employed as a substitute for ether in this method of administration, and with it the total quantity of fluid introduced into the circulation may be reduced by quite one-half. It is also claimed that the anæsthesia is more quickly induced and that there is less tendency to excessive formation of mucus in the air passages; on the other hand the depression is greater, and there is rather more danger of over-dose. Sixty-five grains of hedonal are dissolved in each pint of saline solution.

'After the intravenous administration of ether or hedonal, and more perhaps after the latter, there is a tendency to hæmoglobinuria and allied conditions, and it is doubtful therefore whether these methods ought to be employed in cases of kidney disease or high arterial tension.

'*Intratracheal Insufflation.*—This plan has recently been introduced by Metzler, of the Rockefeller Institution, and is being taken up by several American surgeons (see *Journal of the American Medical Association*, August 12, 1911; and *Annals of Surgery*, February 1911). The patient being first anæsthetised by the ordinary method, a soft catheter (22 or 24 French) is introduced through the mouth and glottis into the trachea, down which it is passed to within 5 cm. of the bifurcation; through this tube a stream of warm air mixed with varying proportions of ether vapour is forced by means of a bellows (see Fig. 10). The return current of air passing through the glottis (which must not be entirely filled up by the catheter) carries with it the blood and mucus, thus obviating the necessity for laryngotomy or plugging the pharynx. The plan is very well spoken of in America.

'In mouth operations it is one particular advantage of both these methods that the anæsthetist is removed from the field of operation entirely, while, as far as the intravenous method is concerned, it has the additional advantage of diminishing the shock and compensating for the loss of blood.'

In performing a *preliminary laryngotomy*, the patient should be in the horizontal position, with the head fully extended, and an incision half an inch long—which may be transverse or vertical—is made directly over the central point of the crico-thyroid space, which should be carefully defined by the left thumb and index finger. The incision goes right down to the membrane, which is then perforated by the knife, with the blade held transversely. This opens the larynx, and along the blade of the knife as it is withdrawn, Butlin's laryngotomy tube and introducer are slipped

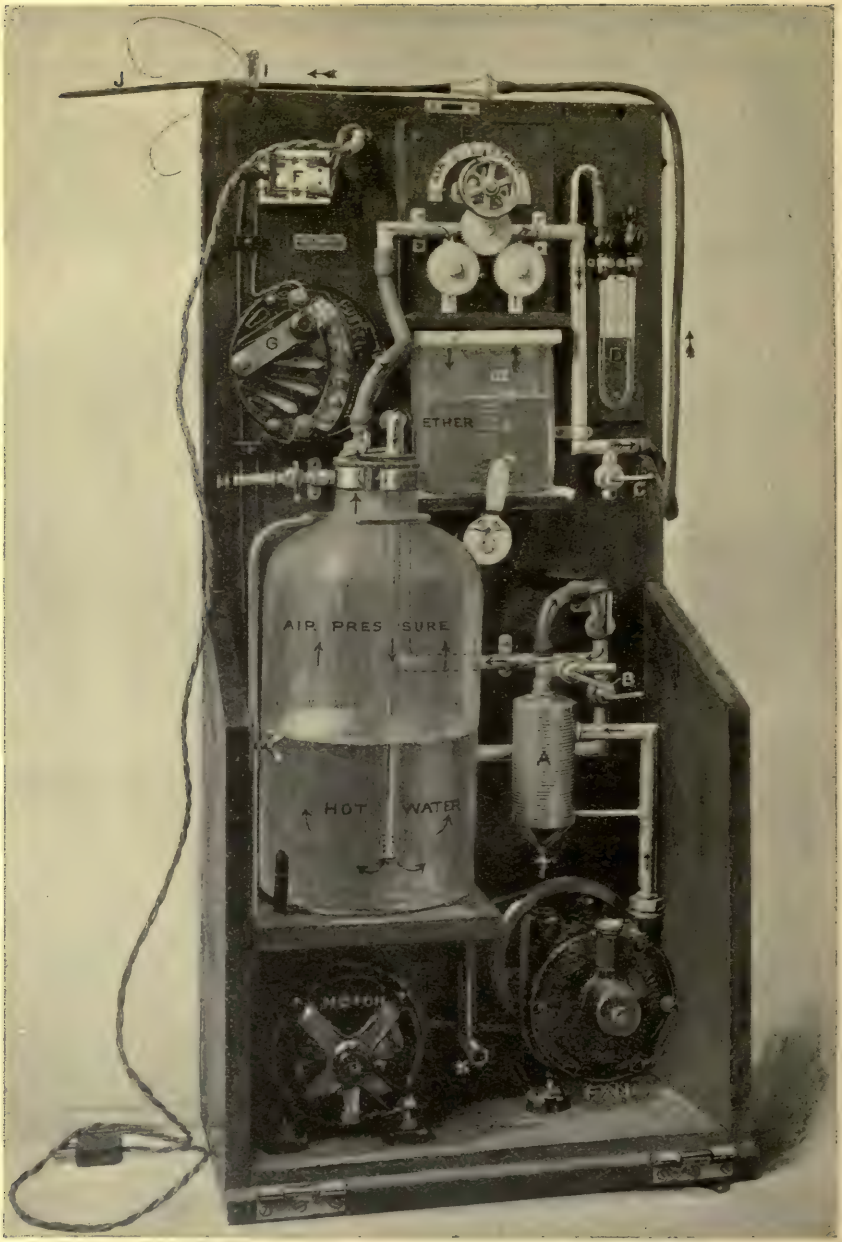


FIG. 10.—ELSBERG'S APPARATUS FOR THE INTRATRACHEAL ADMINISTRATION OF ETHER. The apparatus may be driven electrically or by means of a foot-bellows attached to the tube, K. The air passes along the course marked ⟶ from the fan to the oil-filter, A. It is then warmed and passed over the surface of the ether and thence to the tracheal tube, J. The course of the mixed air and ether is marked ⇛. B is a control-tap regulating the pressure, which is indicated by the manometer, B. C is a deflation-tap; when it is open no mixture passes into the tracheal tube. F and G are the electric switch and rheostat. H is a tube through which oxygen can be added to the mixture. I is the gag to prevent the tube being bitten.

in (see Fig. 11). The tube is tied in, the pharynx plugged with sponges fastened to tapes, the ends of which are left hanging out of the mouth, and the anæsthetic continued by way of the tube if inhalation anæsthesia is being used.

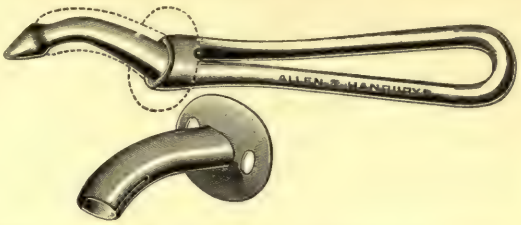


Fig. 11.—Butlin's Laryngotomy Cannula and Introducer.

Excision of the Upper Jaw.—The facial artery is compressed against the jaw, and the surgeon grasps one side of the upper lip between his thumb and forefinger, while the assistant grasps the other, so as to control the coronary arteries. The upper lip is divided in the middle line right up to the columella, and the incision is carried along the margin of the nostril curving around the ala of the nose up to the inner angle of the orbit, just below the lachrymal sac. From this point, it runs outwards along the lower margin of the orbit to within about half an inch of its outer end (see Fig. 12). When the malar bone is involved and a very extensive operation is necessary, it may be advisable to carry the incision out as far as the latter bone. When, on the other hand, the operation deals chiefly with the lower part of the maxilla, this part of the incision can be made shorter, or dispensed with altogether; the shorter it is, the less is the orbicularis damaged, and when it does not extend as far out as the malar bone, the nerve supply of the muscle remains intact.

Fig. 12.—Incision for Removal of the Upper Jaw. The incision, *bc*, is used for partial operations; the limb, *ab*, along the lower margin of the orbit being used if necessary or if the entire bone has to be removed. The lower incision, *de*, is for excision of the lower jaw.

The flap thus marked out is rapidly raised, care being taken to avoid going too near to the tumour; any portion of the skin that may appear to be involved must be excised. The flap should be cleared right back to the tubercle on the under edge of the malar bone. When this has been done, sponges are applied firmly over the surface, and the chief bleeding points are seized and twisted. If the oozing from the small arteries is obstinate, the application of adrenalin chloride (1 in 1000) is very efficacious. The most troublesome bleeding occurs about the inner angle of the orbit; it is chiefly venous and usually stops after a time if the bleeding points

are grasped in forceps. The next step is to detach the periosteum from the orbital margin and push it upwards, carrying with it the orbital fat and the eye, and to keep the latter out of harm's way by means of a suitable spatula.

The surgeon then divides the various connections of the upper jaw. The junction of the malar bone with the maxilla is first sawn through, keeping the saw in the line of the spheno-maxillary fissure, and then the nasal process of the maxilla is divided after the soft parts of the nose have been detached from the bony framework. The cut runs obliquely upwards and backwards from the lower edge of the nasal bone to the lachrymal (see Fig. 13); it is completed with cutting-pliers. It is well in some cases to divide the floor of the orbit a little inside the orbital margin of the maxilla, so as to leave a support for the eye. The mouth is next opened with a gag, a central incisor removed and a transverse incision made along the posterior edge of the hard palate, separating the soft palate from the hard, from the middle line to the hamular process. The muco-periosteum of the hard palate is then divided down to the bone in the middle line from behind forwards; the mucous membrane of the floor of the nose is also divided from the edge of the hard palate to the aperture of the nostril by means of a knife passed into the inferior meatus after the ala of the nose has been detached from the bone and pushed well over to the opposite side. The alveolus and the hard palate are next sawn across with a narrow saw introduced into the nose and kept strictly parallel to the palate, for fear of damaging the base of the skull; the division is often completed with a pair of powerful cutting-pliers. The pliers are then used to free the upper jaw finally; one blade is inserted into the nose and one into the orbit along the saw-cut through the nasal process, and (using the bridge of the nose as a fulcrum) the maxilla is forcibly levered out. As soon as the posterior attachments are felt to give way, the jaw is seized with a pair of lion forceps, taking hold of the alveolar and orbital margins, and rapidly twisted out (see Fig. 14).

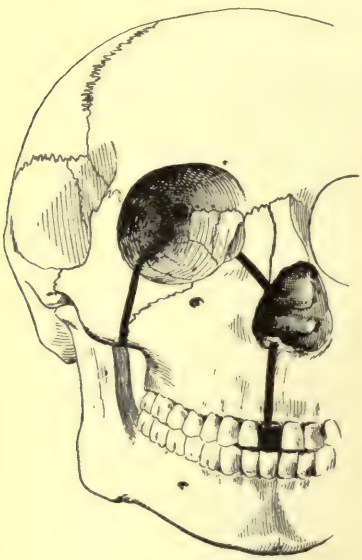


FIG. 13.—LINES OF BONE SECTION IN FERGUSSON'S OPERATION.

In some cases the jaw and the tumour come out intact; when the disease is extensive, it may break and only a part comes away. In

any case large sponges should be packed at once into the cavity from which the jaw has been torn, so as to control the bleeding; these sponges are then cautiously raised, all bleeding points clamped, and the condition of the surface inspected, any remains of the jaw or portions of tumour being clipped away. The bleeding chiefly comes from the pterygo-maxillary fossa, and usually stops on pressure; if vessels of any size bleed, they can be tied.

After the whole tumour has been removed and the bleeding has been arrested, the raw surface should be sponged over with a solution of chloride of zinc (gr. 40 to the oz.), and if there is any oozing going on, the cavity should be packed with iodoform gauze for a few hours. The ends of the gauze should be brought out at the angle of the mouth and tied together with a piece of silk, which is fastened around the ear. The flap is carefully replaced and sutured, the best suture material being silkworm-gut at the angles, with intermediate stitches of horse-hair. Care must be taken that the red line of the lip is accurately adjusted on the two sides; the lip should also be everted and the mucous membrane united as far as the nostril. If this precaution is omitted, the raw surface may become adherent to the divided margin of the alveolus, and imperfect movement of the upper lip will result.

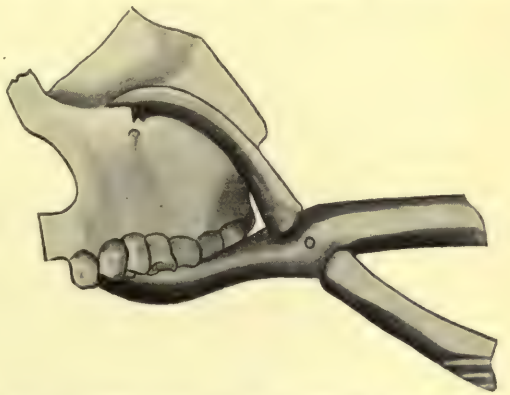


Fig. 14.—Application of Lion Forceps in Removal of the Upper Jaw. One blade is is placed upon the orbital margin, the other upon the alveolar edge.

The sponges are now removed from the pharynx and the laryngotomy tube may be taken out at once, or it may be left in for twelve hours, so as to guard against any risk of emphysema about the wound. If a vertical skin incision has been used for the laryngotomy, there is little risk of emphysema; if a transverse one has been employed, there is a slight risk unless it lies exactly over the incision into the larynx. No dressing is necessary for the facial wound; we generally lay a piece of wet gauze over that side of the face for a few hours until the oozing stops. When the patient is put back to bed, he is propped as upright as possible, both to diminish the venous oozing and to facilitate the escape of the discharges from the mouth.

Difficulties and dangers.—The principal danger in this operation is loss of blood, and every care must be taken to see that the hæmorrhage is checked as quickly as possible; rapidity of operation is very desirable,

especially in the later stages. Sponge pressure nearly always suffices to check the oozing after the jaw has been removed, if it is associated with douching the face with ice-cold water. There is remarkably little shock accompanying the operation, and in the majority of cases the wound heals without any complications. Patients who are very feeble or advanced in age may succumb, however, especially when septic cellulitis or erysipelas attacks the wound or putrid material passes down the air passages and gives rise to septic pneumonia. As a rule, however, the cavity left is so widely open that the discharges escape freely, while the application of the chloride of zinc solution after the operation apparently protects the tissues from sepsis for two or three days. The performance of a preliminary laryngotomy as a routine measure is the best safeguard against infection of the air passages during the operation.

After-treatment.—The packing introduced at the time of the operation should be removed within twenty-four hours at the latest, and should not be reinserted unless there is still serious oozing. The cavity should be cleansed frequently by spraying it from the mouth with a solution of peroxide of hydrogen (10 vols.), boro-glyceride or sanitas, and the patient should wash out the mouth repeatedly with these antiseptic solutions. When the wound is granulating freely, it is a good plan to pack the cavity lightly with gauze before a meal; this forms a roof to the cavity of the mouth, and thus enables the patient to swallow without any food passing up into the large cavity above. For the first two or three days it is well to rely on nutrient enemata and rectal injections of saline solution, so as to avoid accumulation of decomposible food in the mouth; the patient may, however, have plenty of water to drink. If he is feeble, he may be fed from the first by a nasal tube passed through the sound nostril. As soon as the wound begins to granulate, liquid food may be given by the mouth by means of a feeder passed well into the pharynx along the sound side. The mouth must always be well washed out after every feed. After about three weeks, solid or semi-solid food can be taken if the cavity is temporarily plugged with gauze. The patient may generally be allowed to get out of bed after three or four days. In two or three months the contraction of the cavity will be nearly complete, and the patient should then be sent to a dentist to have some apparatus made to fill the cavity and to carry the teeth; the ultimate result is often remarkably good and the deformity slight.

2. Of cases in which the disease is primarily Nasal.—When the growth originates in the nose or in the ethmoidal area of the jaw, and when surgical treatment seems justifiable, the operation described above can be modified—greatly to the patient's comfort—by retaining the palate and part at least of the orbital plate. The operation is often called by the name of Moure, who described it in 1902. It may be conveniently termed Lateral Rhinotomy, and is done as follows:—

Lateral Rhinotomy.—The posterior nares must be plugged, so as to

prevent the blood running back into the pharynx. Some surgeons perform a preliminary laryngotomy and plug the pharynx, but this is unnecessary unless the operation is a very extensive one; the posterior nares can be quite efficiently plugged in the ordinary manner (see Fig. 15). The plug consists of a firm sponge or of boric lint folded to a size that will fill up the posterior nares, and narrow enough to be pulled into it; attached to this is a piece of silk, with both ends long. Special instruments, such as

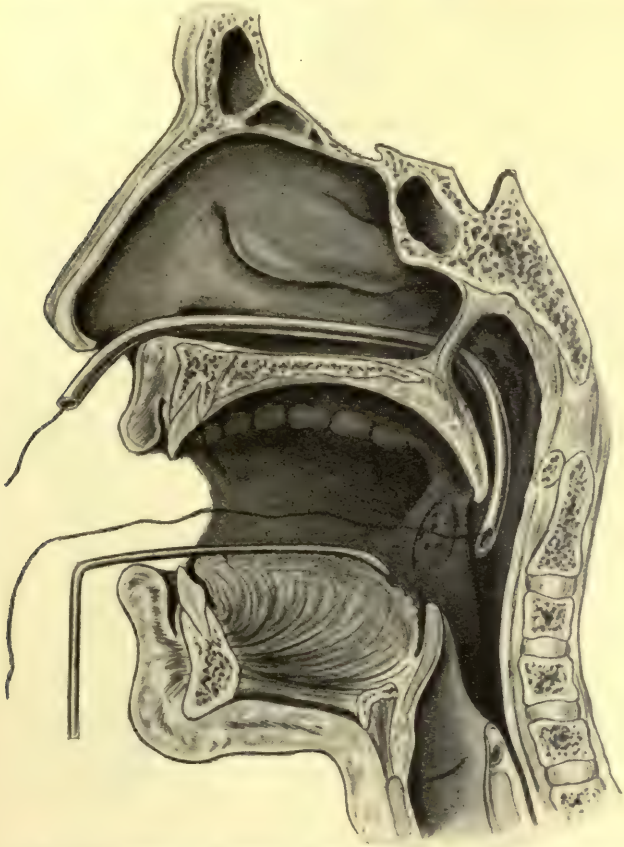


FIG. 15.—PLUGGING THE POSTERIOR NARES. The catheter is shown in place and the thread has been pulled out of the mouth preparatory to attaching to it the string holding the post nasal plug. In practice it is simpler to tie the thread to the end of the catheter than to thread it through it as depicted above.

Bellocq's sound, may be used for the introduction of the plug, but the simplest plan is to take a gum-elastic catheter of small size, pass it through the nostril into the pharynx and then, holding the mouth open, to seize the tip and pull it out of the mouth. The string is then attached to the tip of the catheter, which is withdrawn through the nose, carrying with it the string attached to the plug. The plug is drawn into the mouth, and to avoid injury of the soft palate, it is well to push it back into the pharynx

with the finger ; when it is has disappeared behind the lower edge of the palate, the string in the nostril is pulled upon and the plug drawn up into the posterior nares. The finger is introduced behind the palate to see that the plug is properly in position and the end of the string in the mouth is kept out of the way by an assistant. As a rule, it is well to plug both nostrils.

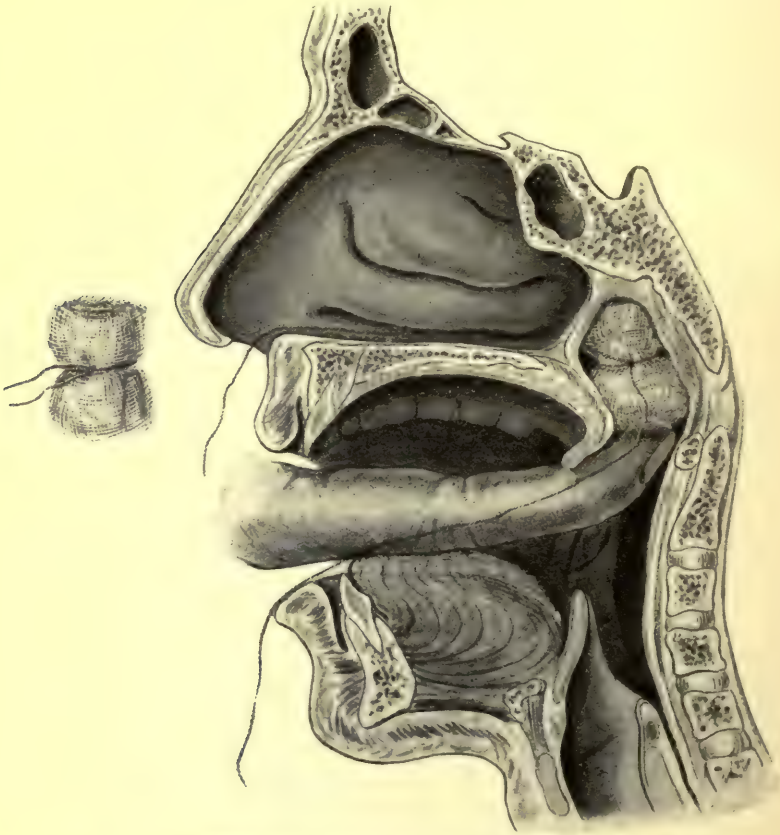


FIG. 16.—THE POSTERIOR NARES PLUGGED. The plug has been drawn up into position above the soft palate. The plug is shown on the left of the figure.

Half an hour before the operation, the nostril on the affected side should be packed lightly with strips of ribbon gauze moistened with equal parts of a 20 per cent. solution of cocaine and 1 in 1000 adrenalin chloride, and left *in situ* until the nasal cavity is reached in the course of the operation. This facilitates accurate work by diminishing the congestion. The surgeon should have a powerful forehead lamp.

The patient lies on the back with the head moderately raised and turned to the affected side. An incision (see Fig. 17) is made very similar

to that for the previous operation, except that it is carried up to the inner end of the eyebrow above. This flap is dissected back, the canine fossa being cleared of the muscles covering it. The soft parts on the affected side are detached from the bony framework and pulled aside. The anterior wall of the antrum is then divided with a chisel obliquely downwards and inwards from the orbital margin just above the infra-orbital foramen to the junction of the outer margin of the bony meatus of the nose with its floor; the infra-orbital nerve should be avoided if possible (see Fig. 18). Stout cutting-pliers are inserted at the lower end of this incision and made to divide the entire length of the bony wall between the antrum and the nose, as near the floor of the nose as possible. The inferior turbinal bone comes away with this portion of the jaw. There is generally smart oozing at this stage, which is best stopped by using hydrogen peroxide (10 vols.). The next step is to remove the nasal bone on the affected side, and with it the whole of the nasal process of the inferior maxilla and most of the lachrymal bone.

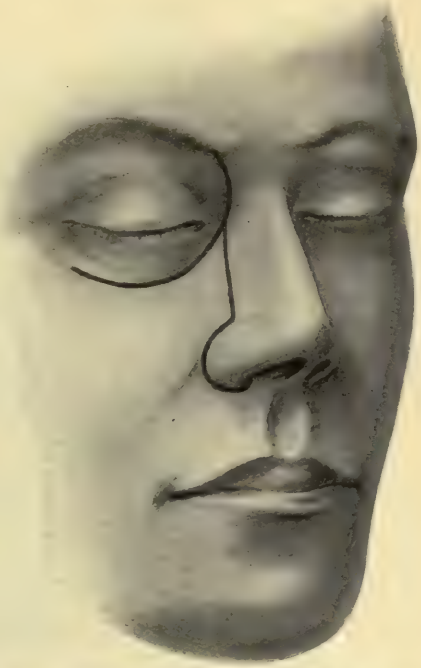


Fig 17.—The Skin-incision for Lateral Rhinotomy.

This operation throws the nasal and antral cavities into one, and exposes the middle turbinal and the ethmoidal area completely, so that either or both can be cleared out, and other areas, such as the sphenoidal or frontal sinuses can also be explored (see Fig. 19). It gives access to the pharynx, and the opening can be enlarged, if necessary, by removing as much of the posterior antral wall as may seem desirable. The exact limits of the tumour can be ascertained and its removal effected by knife, cautery, or sharp spoon, as circumstances direct. Bleeding is fairly free until the tumour has been got away; packing with ribbon gauze or douching with peroxide of hydrogen are the best preventives; it is rarely dangerous.

After all the disease has been removed, the oozing from the cavity left is checked by douching with peroxide of hydrogen, and the interior inspected with the aid of the electric forehead lamp. Any suspicious

tissues are removed with scissors or cutting-pliers, or destroyed freely with the thermo-cautery. The skin wound is then united accurately as in Fergusson's operation (see p. 37). No drainage tube or packing is required. The post-nasal plug is removed as soon as the patient is conscious, when he is treated exactly as after Fergusson's operation.

3. Of cases in which the growth is primarily Alveolar.—When the disease spreads to the body of the upper jaw from the alveolus the extent of the operation will vary within very wide limits, and will depend upon the size of the growth, and the amount of implication of the

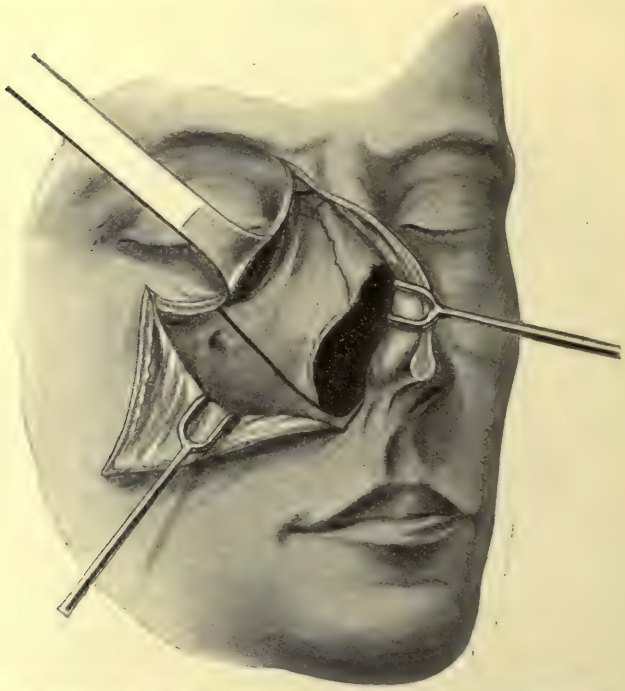


FIG. 18.—THE LINES OF INCISION IN THE BONE IN LATERAL RHINOTOMY.

jaw. In the mildest cases—usually those in which the growth arises in connection with a carious tooth or a badly-fitting denture—it may suffice to remove only the subjacent alveolus and palate process without opening the antral cavity. But in the cases generally seen, it will be necessary to open the antrum freely, remove most, if not all, of the palate process, and as much as may be necessary of the anterior and outer walls of the antrum, so as to get wide of the growth. In all cases the incision through the muco-periosteum should be at least half an inch wide of the margin of the growth all round.

The operation is simple. No packing is required until the wound is granulating, when it is used to keep food out of the antrum. When

healing is complete, a well-fitting denture will restore the speech in all cases where it has not been necessary to remove any of the soft palate. The eye is, of course, unaffected since the orbital plate is not interfered with.

4. Of cases in which the growth is confined to the Orbital area.—In a good many of these cases, the operation described for the nasal group of tumours (see p. 38) will suit, if enough of the orbital plate and the anterior antral wall are taken away to make sure of the free removal of the tumour.

In other cases, however, the infection of the antral mucous membrane

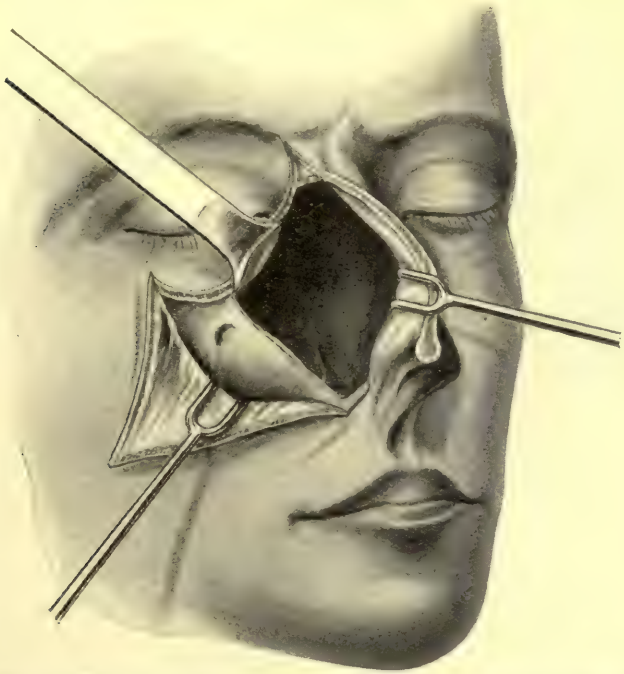
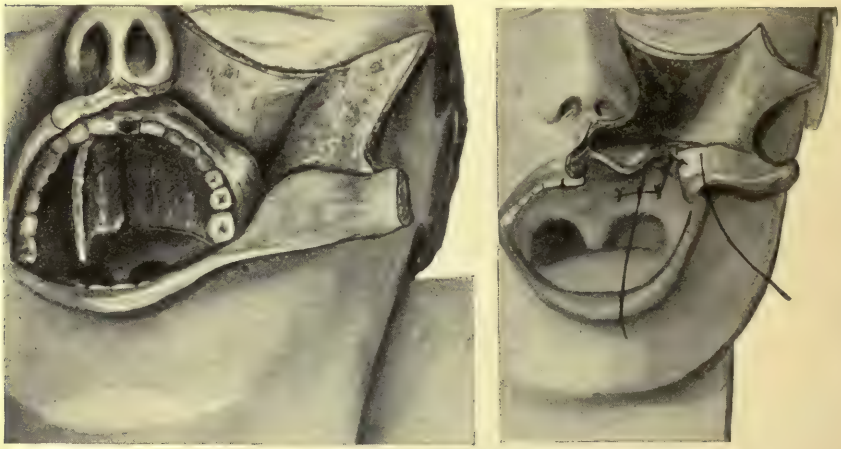


FIG. 19.—EXPOSURE OF THE ANTRAL CAVITY IN LATERAL RHINOTOMY. The antral and nasal cavities are laid into one by the removal of the inner wall of the antrum and the inferior turbinal bone.

may be more extensive, and require removal of the upper jaw, but here the question may arise whether it is not possible to leave the hard palate. In most cases, this is not advisable, but in those in which the disease is essentially at the upper part, and the involvement of the floor of the antrum is only slight, it may be possible to save at least the muco-periosteum of the hard palate, and attach it afterwards to the cheek, so as to shut off the nasal cavity from the mouth. When this is decided on, the operation follows the lines of Fergusson's, but, instead of taking away the muco-periosteum of the hard palate with the bone, an incision is carried along the hard palate on the side affected, just inside the teeth,

extending from the hamular process to a little beyond the middle line in front, and the muco-periosteum is raised with an elevator as far as the middle line (see Fig. 20, *A*), as in the operation for cleft palate. It is well to divide the soft palate from the hard by a transverse cut; this can be stitched up afterwards. After the operation has been completed, the free edge of this muco-periosteal flap is stitched with catgut to the line of division of the mucous membrane on the inner side of the cheek, and the incision between it and the soft palate is similarly united (see Fig. 20); the nasal cavity is thus shut off from the mouth. It is best not to employ packing, except when there is free oozing and then only



A *B*

FIG. 20.—PRESERVATION OF THE PALATE IN PARTIAL RESECTION OF THE MAXILLA. *A* shows the muco-periosteum of the hard palate incised along the alveolar margin, divided from the soft palate and reflected from the bone as far as the middle line. *B* shows how it is sutured in place after removal of the bone, so as to shut off the mouth from the cavity left.

for the first few hours; any strips of gauze put in at the time of the operation can be pulled out through the nostril.

In some cases the skin incisions must be modified so as to remove portions of the skin over the tumour when the latter is suspiciously near the surface. Under such circumstances, a plastic operation will be required, either at the time of the operation or at a later period, in order to cover up the defect; when possible, the plastic operation should be done at the time. Sometimes, however, the gap is so large that it is impossible to close it in this way, and then it may be best to leave it open and cover it with a flesh-coloured plate held in position by spectacles. This has the great advantage that the cavity can be inspected and any sign of recurrence treated at once by the application of caustics, radium, or the X-rays (see Vol. II. p. 23), if a further operation is not desirable.

Removal of the Lymphatic Glands.—In all cases of malignant tumours of the upper jaw, the question of the removal of the glands will arise. There is no doubt that the entire lymphatic area in the submaxillary region and the anterior triangle on the affected side should be removed in all cases of epithelioma, but this is better done at a subsequent period—about two or three weeks after the operation on the jaw. In the case of a sarcoma, this operation is not necessary unless the glands are enlarged. The details of these operations are given in connection with cancer of the tongue.

MALIGNANT TUMOURS OF THE LOWER JAW.

In the lower jaw, as in the upper, new growths may arise subperiosteally or in the substance of the bone. Epitheliomata of the lower jaw, due to extension of the growth from the floor of the mouth or the tongue to the adjacent portions of the jaw, are quite common; primary malignant tumours of the lower jaw, either periosteal or endosteal, are also frequently met with.

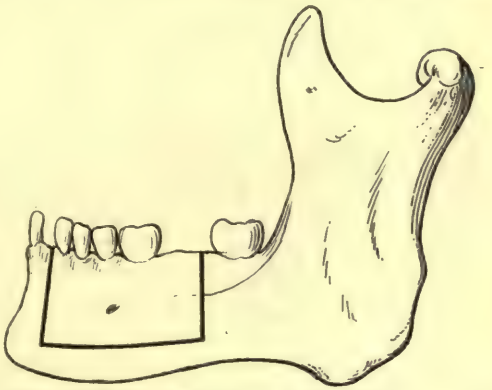


FIG. 21.—PARTIAL RESECTION OF THE MANDIBLE. The dark line shows how a portion of the bone is removed, leaving its lower border intact.

TREATMENT.—In cases of epithelioma affecting the alveolus and not spreading into the substance of the bone, it is sometimes possible to remove the affected portion without destroying the continuity of the lower jaw; this is a point of extreme importance, because when a portion of the whole thickness of the jaw is removed, the line of the teeth is so altered that proper mastication can no longer be performed. Hence, a bridge of bone should be left below whenever it is possible.

Removal of portions of the Jaw without destroying its continuity.—The mucous membrane must be divided some distance from the ulcer after the extraction of the necessary teeth, and then the included portion of bone is removed by vertical saw-cuts joined transversely at the lower part by means of Gigli's saw (see Fig. 21). The skin incision will vary according to circumstances. In most cases it is best to carry a curved incision along the lower margin of the jaw and to turn the cheek upwards; if the tumour is extensive, it may be necessary also to divide the lower lip completely in the middle line. Occasionally it may be more convenient both for the operation on the bone and also

for that on the tongue, or whatever part the disease is spreading from, to split the cheek outwards towards the masseter. The incisions required for these cases will be described either in connection with excision of the lower jaw (*vide infra*) or with cancer of the tongue and floor of the mouth (see Chap. IX.). The point which we wish to emphasise here is that a bridge of bone connecting the anterior and posterior parts of the jaw should be left intact whenever this is possible, and this can usually be done by making an incision below the jaw and turning up the soft tissues.

Tumours growing elsewhere than in the alveolus usually involve the removal of the whole thickness of the affected portion of the jaw, and the following operations may be required according to the extent and seat of the tumour :—

1. Excision of one-half of the jaw.
2. Excision of the horizontal ramus or portions of it on one side of the symphysis.
3. Excision of the symphysis.
4. Excision of the entire jaw.

FIG. 22.—INCISION FOR REMOVAL OF THE MANDIBLE. The incision, *de*, is for excision of the mandible.

Removal of one-half of the Lower Jaw.—The patient is propped up by pillows beneath the shoulders, and the head allowed to hang back over a sand-bag and turned to the sound side. Chloroform should be administered ; laryngotomy is unnecessary unless the growth extends beyond the limits of the jaw and involves an extensive operation, in which case it is carried out in the manner described on p. 33. The finger is thrust between the lower lip and the gum in the middle line, and made to define the reflection of the buccal mucous membrane on to the jaw. The knife is then introduced through the skin, just below this point, and carried thence vertically down to the edge of the jaw, after which it runs about an inch below the lower border of the horizontal ramus as far back as the angle, where it turns up along the posterior border of the ascending ramus to the lobule of the ear (see Fig. 22). This incision is deepened and the facial vessels are clamped and divided. The flap—which should not take up any of the muscles attached to the jaw—is then raised until the line of reflection of the mucous membrane on to the jaw is reached, but at this stage the buccal cavity should not be opened.

The soft parts are next separated from the inner surface of the jaw, beginning at its lower border ; the muscles attached to the jaw are

divided high up and removed with the latter. The dissection on the inner side should be carried up to the mucous membrane, but not through it, and up to this point there will be no trouble from blood running into the pharynx; all the vessels bleed externally and can be clamped. The lateral incisor tooth on the affected side is now extracted, the mucous membrane punctured on both aspects of the jaw, and the bone divided with a fine saw, a little to one side of the middle line, so as to leave the attachment of the tongue muscles. A less tedious way than using an ordinary saw is to pass Gigli's wire-saw round the bone by means of an introducer (see Vol. III. p. 33) and divide the bone with it. When the bone has been cut across, the flap is held up and the mucous membrane is divided all along the outer side of the jaw, after which, the divided half of the jaw is pulled outwards and the mucous membrane on the inner side also divided, where it is reflected from the floor of the mouth. The divided half of the jaw is now forcibly depressed, while the flap is hooked up; this brings the coronoid process into view, and, by cutting on it, the tendon of the temporal muscle is gradually divided; the jaw can then be depressed much more freely. In some cases, either because the size of the tumour prevents proper depression of the jaw, or because of the extra length of the coronoid process, it is difficult to divide the muscle satisfactorily, and, under such circumstances, it is best to cut across the coronoid process with bone pliers and dissect it out after the jaw has been removed.

Finally, the jaw is still further depressed and pulled outwards while the ligaments around the articulation are divided. In some cases, the jaw can be pulled out forcibly, but it is generally well to divide the external ligaments at any rate. Care must be taken to cut close to the bone and, in turning the jaw outwards, special care must be taken not to twist the soft parts out with it, otherwise the internal maxillary artery may be torn. When the ligaments on the outer side are divided, the jaw generally comes away quite readily.

After the jaw has been removed, the soft parts must be carefully examined to see that no growth is left behind; the submaxillary triangle should also be investigated to make sure that there is no glandular disease. The bleeding is arrested, the raw surface sponged over with chloride of zinc solution (gr. 40 to the oz.), and the incision sutured with silkworm-gut or horse-hair. If possible, the mucous surfaces should be brought together with catgut stitches. It is well to introduce a drainage tube opposite the angle of the jaw; cyanide gauze dressings are applied. The patient is put back to bed, propped up with pillows and the head turned towards the side operated on, so that the discharge may escape freely.

After-treatment.—To check the capillary bleeding, the patient may suck small pieces of ice wrapped in muslin, or he may use an adrenalin mouth-wash. The dressing will require changing several times a day

for the first few days. After the fifth day, the drainage tube can be taken out and shortened and put back in the external part of the track. The tube can usually be left out about the tenth day, by which time the whole incision will be healed with the exception of the drainage tube track.

For the first two or three days, the patient must be fed mainly by enemata unless he is very feeble, but he may have plenty of water by the mouth. At first he finds it difficult to swallow, and putrescible food may lie in the wound and increase the septic troubles. In two or three days, however, the tissues are sealed off, and liquid nourishment may then be given by the mouth, the fluid being put in a feeder to which a piece of india-rubber tubing is attached, and carried well back towards the pharynx on the sound side. It is well to turn the head to the sound side and rather depress it when taking food, so that the fluid runs down along the healthy mucous membrane and does not come in contact with the raw surface. If this is not tolerated, the nasal tube may be used. After taking food, the mouth must be thoroughly washed out. At the end of a week semi-solid food may be given, and usually the patient may be allowed to get up. The bowels should be kept freely open and the mouth frequently syringed with antiseptic lotions, especially after taking food.

The operation often requires modification according to the size and situation of the tumour. In some cases portions of the skin over the tumour must be taken away ; a plastic operation is then necessary. As a rule, it is unnecessary to cut through the free margin of the lip at the anterior end of the incision, but when the tumour is of great size, it may be impossible to avoid doing this ; care must then be taken in suturing the incision to see that the red line is in accurate apposition.

When the jaw is much destroyed by the growth, fracture may take place when attempting to disarticulate it ; under these circumstances, the fractured portion should be detached as rapidly as possible and the ascending ramus of the bone seized with lion forceps, pulled downwards, and twisted or dissected out as before.

Removal of the Horizontal Ramus alone.—When the tumour is endosteal and well limited, or when it is a small epithelioma, the ascending ramus may sometimes be left behind. The method is similar to that already described, except that, instead of detaching the coronoid process and disarticulating, the jaw is sawn across at the angle.

When the ascending ramus is left, it is well to try to keep the teeth on the sound side in proper position, in some more effectual manner than by the use of inter-dental splints. A method by which the gap can be kept open, and which is convenient in some cases, is by bridging it with a bar of nickeled steel or an ivory peg fixed into the bone. Holes are drilled on each side to receive the metal peg, the length of which is such that the gap shall be of proper width when the ends are fixed into these

holes. The only trouble is that the holes enlarge by inflammatory action, and the pegs get loose and may even fall out in the course of time. As a rule, however, the contraction of the scar prevents them from falling out if they have been buried sufficiently deeply in the jaw. If it has been possible to obtain an impression of the mouth before operation, and if these rods have been cut to the right length, a dental splint may be made later on, which will help still further to keep the fragments apart.

Removal of the Symphysis.—Excision of the central portion of the jaw alone is required when epithelioma has spread from the floor of the mouth and infiltrated the periosteum in the neighbourhood of the symphysis. The removal of this portion of the jaw involves complete detachment of the muscles which hold the tongue forward, and this is the chief trouble in the after-treatment. The removal itself is simple enough and hardly requires description. The skin must be divided along the lower margin of the jaw for the requisite distance; the necessary teeth are extracted, the bone is sawn through on each side, and the intervening part is then removed along with the affected soft parts. Before the bone is removed, the tongue should be seized with forceps so as to prevent it falling back and choking the patient.

In all cases of removal of the symphysis, it is necessary to try to prevent the two divided surfaces coming together, otherwise the lower jaw becomes hopelessly contracted and the teeth in it lie on a plane greatly posterior to those in the upper. Two nickeled steel rods, one fixed in the lower and the other in the upper border of the jaw, may be used with advantage, or the two halves may be connected by a bent Lane's plate. A stitch should be put through the muscles of the tongue and fastened over the steel pins or plate, so as to keep the tongue forward; in the course of three or four days, when the wound is granulating and the parts are becoming consolidated, the tongue will retain its position. The best material for this stitch is silkworm-gut, which does not become septic in the same way that a silk suture does; when the rods are not used, a pair of catch forceps may take the place of the stitch and will keep the tongue forward by their weight. When the rods or plates are employed and an impression of the bite can be taken before operation, it is very important to get a dental splint made to reinforce the rods and keep the two halves of the jaws apart; this requires the aid of a skilled dentist.

Removal of the entire Jaw.—In some cases the whole of the jaw may require removal; this is done practically in the same way as above described, each half of the jaw being removed separately. The patient's condition afterwards is, however, very lamentable.

Removal of the Glands.—In all cases of epithelioma and in those of the more malignant forms of sarcoma, the lymphatic glands in the submaxillary and anterior triangles must be removed. This question is dealt with fully in connection with malignant disease of the tongue, of which carcinomatous disease of the jaw is often a mere extension (see Chap. IX.).

CHAPTER V.

TUMOURS OF THE NASO-PHARYNX.

TUMOURS in the naso-pharynx may be either polypoid or sessile, simple or malignant. The ordinary naso-pharyngeal polypi may be simple fibromata, but, perhaps, most frequently they are fibro-sarcomata, and are very apt to recur unless carefully removed. They generally have a broad attachment to the under surface of the sphenoid, and often run forwards on to the posterior part of the roof of the nose. They are usually firm and contain large blood-vessels, especially venous sinuses, and the vessels do not lie in a sheath and therefore do not retract when divided; hence, incision into one of these naso-pharyngeal polypi is usually followed by furious bleeding, which does not cease spontaneously. The naso-pharyngeal polypi grow with varying rapidity according to their nature. They fill up the naso-pharynx, bulge down the soft palate and may even escape behind the latter and project into the pharynx itself; they also grow forward into the posterior part of the nose. The surface frequently becomes abraded, and severe bleeding is common. Hence, it is necessary to attempt the removal of these tumours whenever this is possible.

TREATMENT.—Attempts have been frequently made to remove these tumours by means of a wire loop, an écraseur, or the galvanic wire, but they are not to be recommended. Apart from the difficulty of getting the loop round the base of the growth, the great objection is, that only the neck of the tumour is cut across and the base is left behind and bleeds severely, and later it tends to grow quickly. Hence, in most cases, it is well to expose the base of the tumour more thoroughly, and remove it along with the periosteum from which it grows.

We shall here indicate the chief routes by which the polypi can be got at; the actual details of these operations need not be given, because there is no urgency in the operation, as a rule, and the various plans can be considered at leisure.

In one set of operations, the tumour is got at *through the mouth.* Of these probably the best is that introduced by Nélaton, which consists

in splitting the uvula and soft palate and carrying the incision forwards in the middle line to about the centre of the hard palate. At the anterior end, transverse incisions are made halfway across the hard palate on each side, and muco-periosteal flaps are raised (see Fig. 23). In this way the posterior part of the bony palate is exposed and is chipped away with a chisel. When this bone has been removed, the mucous membrane of the floor of the nose is exposed and also the septum, and the former is divided close to the septum and turned aside; such portions of the septum are clipped away as may be necessary to expose the base of the tumour. The result is that a view of the growth is obtained, although the operation does not give good access to its base. It certainly is sufficient to allow an écraseur loop to be passed around the tumour through the nose; when the main mass of the tumour has been removed in this way, the periosteum from which it is growing can be peeled off, provided that the bleeding can be checked in the meantime. Cutting through the pedicle is apt, however, to be followed by very severe bleeding, which is difficult to check, and the operator may be unable to go on to the complete removal of the pedicle. A preliminary laryngotomy should always be done.

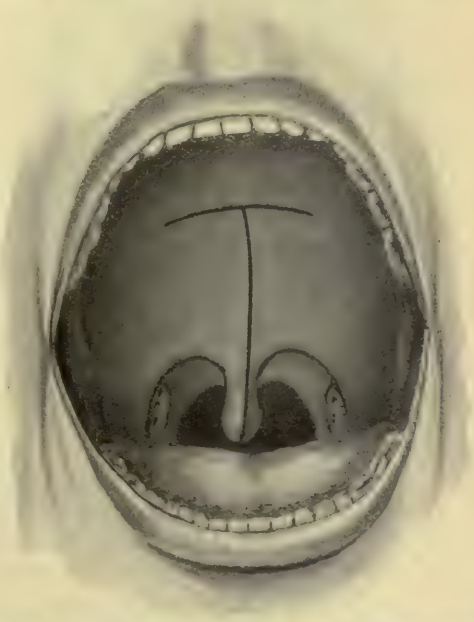


FIG. 23.—NÉLATON'S OPERATION FOR NASO-PHARYNGEAL POLYPI. *The earlier stage of the operation.* The palate is divided along the dark lines.

In cases of malignant polypi about the back of the nose it is best to *remove portions of the upper jaw* rather than to attempt to work through a small opening in the mouth. In some cases, the operation for malignant intranasal growths, described on p. 38, gives sufficient access; in others, especially when the growth infringes on the lateral part of the pharyngeal vault, a modification of Fergusson's operation (see p. 35) may be used. It is not necessary to remove the orbital plate, nor the muco-periosteum of the hard palate, but it may be well to take away the rest of the bone, and if the muco-periosteum of the hard palate be turned aside, in the way already described (see p. 44), and an incision carried through the bone below the orbital margin, the lower part of the maxilla

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can be removed by dividing the palatal process to one side of the middle line, the frontal process of the bone below the orbital margin, and the malar process externally. The posterior part of the antrum, which generally breaks off, can be chipped away, and, if necessary, the pterygoid process can be removed; in this way free access is obtained to the naso-pharynx. The base of the tumour can then be dealt with properly. The deformity resulting from an operation of this kind is slight, as the incision need not be carried far out along the orbital margin, and hardly shows when carefully united, while the cavity left is shut off from the mouth by the hard palate; the sinking-in of the cheek is not marked, since no portion of the malar bone need be taken away.

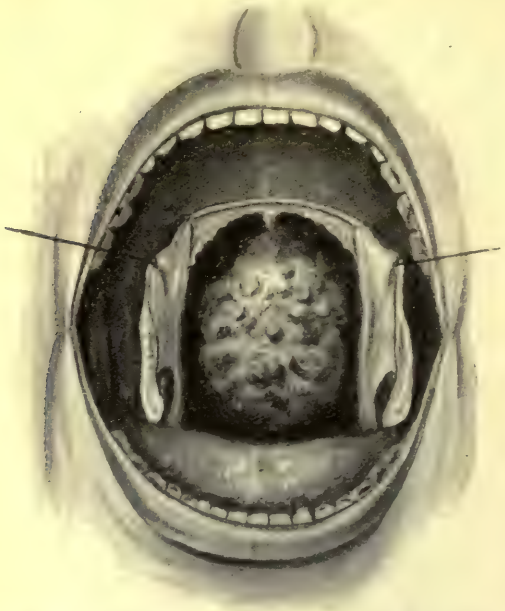


FIG. 24. — NÉLATON'S OPERATION FOR NASO-PHARYNGEAL POLYPI. *Exposure of the growth.* The divided palate is pulled aside by sutures.

When the tumour is malignant and sessile, no operation short of a partial excision of the upper jaw, such as the above, will give satisfactory access to the part; with such an operation, there is a perfect view into the naso-pharynx if the pterygoid process is also cut through. Such a procedure will be found described in the Lettsomian Lectures for 1897.[1] In the case detailed in these lectures the access to the disease, after removal of the lower part of the upper jaw and the pterygoid processes, was perfect, and, although a portion of the Eustachian tube was involved, it was taken away thoroughly and with practically no bleeding. A preliminary laryngotomy should be performed.

[1] See also *Objects and Limits of Operations for Cancer*, by W. Watson Cheyne. Baillière, Tyndall & Cox. 1897.

SECTION II.—AFFECTIONS OF THE TONGUE AND FLOOR OF THE MOUTH.

CHAPTER VI.

CONGENITAL MALFORMATIONS, INJURIES, AND INFLAMMATORY AFFECTIONS OF THE TONGUE.

CONGENITAL AFFECTIONS.

CONGENITAL deformities of the tongue, such as deficiency, undue length, or a bifid condition of the organ, are very rare, as is also the congenital form of macroglossia; these deformities are not amenable to surgical treatment. The form of macroglossia, due to lymphangioma, is considered in Chap. VIII.

TONGUE-TIE.

This condition, which is also known as anchyloglossia, is a congenital deformity in which the frenum linguæ is abnormally short and the tongue cannot be protruded properly; it generally improves as the child gets older, and seldom calls for treatment.

TREATMENT.—Formerly the frenum was very frequently divided for supposed tongue-tie, but this is unnecessary in the majority of cases, as it gradually lengthens as the child gets older; the operation, moreover, may be followed by a scar which may tie down the tip of the tongue and exaggerate the original trouble.

In some cases, however, the frenum is extremely short and it is necessary to divide it. It should then be incised transversely close to the symphysis, so as to leave the portion beneath the tip of the tongue uninjured, and in bad cases it is well—after pulling up the tip of the organ and thus converting the original transverse incision into a lozenge-shaped space—to bring the sides of the latter together with one or two catgut

stitches. In performing the operation the tip of the tongue should be lifted up with two fingers of the left hand so as to make the frenum taut, and the latter is snipped across with a pair of blunt-pointed scissors. The two fingers of the left hand then push the tip of the tongue forcibly back so as to enlarge the incision thus made without running the risk of dividing any of the veins that a more extensive incision would involve. In the less severe cases in which stitches are not required, no anæsthetic is necessary, as the entire procedure occupies only a few seconds. No special after-treatment is called for.

INJURIES.

WOUNDS.

The most common wound of the tongue is *laceration* from a bite, such as frequently occurs in epileptics, the tongue being protruded between the teeth and bitten as the jaws come together during the convulsion. This accident sometimes occurs when a child is running with the tongue protruded and falls upon the chin, snapping the jaws together and biting the tongue. *Incised wounds* of the tongue are rare.

TREATMENT.—In epileptics the frequency of this occurrence must be borne in mind, and when a fit is imminent, a cork, a roll of bandage, or a piece of wood should be inserted between the teeth, and held there during the fit so as to prevent the tongue being bitten. These injuries usually heal without any trouble, but in some cases severe septic inflammation may ensue. As a rule, the *hæmorrhage* is not severe enough to call for any special treatment for its arrest. When the bleeding is serious the patient should be placed in a good light, the mouth opened wide, the tongue protruded and the cut surface dabbed over with a pledget of wool soaked in a 10 per cent. solution of cocaine. Any spouting vessel should be seized in artery forceps and tied with catgut; if the surface simply oozes, a pledget of wool soaked in adrenalin chloride (1 in 1000) applied to the surface, or a piece of ice wrapped in muslin and placed in the mouth, will check it readily. When the wound is large, it is a good plan to put in a few catgut *stitches* deeply through its edges so as to press the lateral surfaces together; this arrests the bleeding and closes the wound.

An antiseptic mouth-wash (*e.g.* equal parts of a saturated boric solution and water, a tablespoonful of sanitas to the pint of water, or a weak solution of permanganate of potash) should be used at frequent intervals. For forty-eight hours the patient should be kept on a fluid or semi-fluid diet, which is passed along the sound side of the mouth, the head being held over to that side in order to facilitate the passage of the food; immediately afterwards the mouth should be rinsed with the mouth-wash prescribed.

BURNS AND SCALDS.

These affections are not uncommon in children as the result of playing with the spout of a kettle and inhaling the steam or swallowing the boiling water. They may also result from the accidental or intentional swallowing of caustic fluids, such as a mineral acid or a caustic alkali. As a rule, the effect of the irritant upon the tongue is quite overshadowed by the symptoms produced by the burn or scald of the pharynx, which almost invariably accompanies it. The tongue swells up and becomes very painful; blisters and subsequently ulcers may form on it, and if there is much swelling about its base, respiration may be seriously interfered with.

TREATMENT.—Ice may be given to suck and any blisters should be pricked at once; should excessive swelling occur, *superficial incisions* must be made in the tongue to allow the escape of the œdematous fluid. These incisions should run parallel to the raphe, and should be made from behind forwards over the most swollen areas; they need only go through the mucous membrane. Cocaine (10 per cent.) gives a sufficient anæsthesia; a general anæsthetic should be avoided on account of the danger to respiration caused by the swelling of the tongue.

INFLAMMATORY AFFECTIONS.

Two forms of inflammation of the tongue may be met with, the parenchymatous and the superficial.

ACUTE PARENCHYMATOUS GLOSSITIS.

This is a comparatively rare affection, which may follow infectious fevers, such as erysipelas or scarlet fever; it may also occur as a sequel to some ulcer of the tongue or floor of the mouth, or be caused by a bite or sting of a venomous insect. A less severe form may result from mercurial poisoning. Sometimes the affection implicates the whole of the tongue; sometimes, but more rarely, only one half (hemiglossitis)—or occasionally the base—is affected.

If seen early and carefully treated, the condition generally ends in resolution, but sometimes suppuration takes place and an abscess forms, —usually between the genio-hyoglossus muscles. When the inflammation is acute, and especially when it affects the base of the tongue, there may be serious embarrassment to respiration. This form of glossitis may be the starting-point of the condition known as Ludwig's angina (see Chap. X.).

TREATMENT.—The first point is to prevent excessive swelling of

the tongue. A *purge* (calomel gr. v or mist. alb. ℥jss) should be administered, and *an antiseptic mouth-wash* (boric acid, sanitas, or Condy's fluid), as hot as the patient can bear it, should be used every half hour. If the case is acute, but without embarrassment to respiration, four or five *leeches* (see Vol. I. p. 5) may be applied externally over the hyoid region. Should these measures fail to relieve the swelling, or should the latter become so marked as to give rise to dyspnœa, the best plan is to make *free incisions* into the tongue under a general anæsthetic; gas or gas and oxygen will usually suffice. The incisions should be made on the dorsum of the tongue, on one or both sides, according as half or the whole is affected, and should run parallel to the long axis of the tongue throughout its whole length, extending well down into the muscular tissue. Bleeding should be encouraged by the employment of *hot boric mouth-washes.* The object of the incisions is to favour free escape of the œdematous fluid, and so diminish the swelling of the tongue.

Abscess of the Tongue.—Abscess most commonly forms between the genio-hyoglossus muscles, so that by pulling up the tongue with forceps, incising the mucous membrane a little to one side of the middle line (taking care to keep well internal to the ranine artery), and then pushing sinus forceps into the substance of the tongue in the direction of the abscess, the pus can be evacuated. A free opening should be made and the wound kept open by introducing a strip of gauze into the cavity; this should be changed twice daily until the cavity has contracted sufficiently. The condition will subside quickly unless the infection is streptococcal, when the condition known as Ludwig's angina (see Chap. X.) may set in.

ACUTE SUPERFICIAL GLOSSITIS.

1. The most common form of acute superficial glossitis is that met with in connection with the growth of the 'oïdium albicans' in the mucous membrane in children and weakly adults—the affection known as '*thrush.*' In this condition whitish spots appear on the mucous membrane of the tongue, palate, cheek, tonsils, or pharynx; they increase in size rapidly, and coalesce to form fairly large patches. The patient generally feels ill, and there is usually diarrhœa. In adults the affection is most common in those who are prostrated by severe disease such as phthisis.

2. Acute superficial glossitis often accompanies ulceration of the mucous membrane of the mouth—the so-called *ulcerative stomatitis.*

3. An eruption of *herpes* may occur on one half of the tongue leading to a superficial inflammation accompanied by the formation of vesicles and minute ulcers.

Acute superficial glossitis may also occur in connection with *foot-and-mouth disease.*

TREATMENT.—1. *Of 'thrush'*: The strictest cleanliness must be observed with regard to the feeding vessels; the proper sterilisation of the milk, from which the organism usually comes, is also most important. The best application is glycerinum acidi carbolici diluted with about three parts of water, or glycerinum boracis, and painted on several times a day. A dose of calomel (gr. i–iv, according to the age of the patient) should be given occasionally, and the patient should be placed under the best hygienic conditions possible.

2. *Of the ulcerative form.*—The treatment of the inflammation of the tongue in these cases is merely that necessary for the treatment of the ulcerative stomatitis (see p. 18).

3. *Of herpetic inflammation.*—This condition calls for little treatment beyond the use of antiseptic mouth-washes, such as chlorate of potash (gr. xv to the oz.) or sanitas. In the later stages a more astringent mouth-wash, such as one containing alum (gr. ij–v to the oz.), is useful.

SUB-ACUTE SUPERFICIAL GLOSSITIS.

The sub-acute forms of superficial glossitis are chiefly of clinical and pathological interest, as there is little to be done for them in the way of treatment. Chief among them is the condition variously described as 'wandering rash,' or 'ringworm of the tongue,' in which smooth, red, slightly elevated patches of a circular or oval shape occur, generally on the dorsum of the tongue. These run together, or the rings enlarge and lose their circular shape, or disappear in one place and appear in another. The condition is usually discovered accidentally, although in some cases it gives rise to troublesome irritation. The disease occurs mainly in children, and its cause is unknown.

TREATMENT.—Tonics should be given, and various local anodyne and antiseptic applications may be employed. Although the condition does not yield readily to treatment, the patient may be assured that it is not likely to be followed by any serious result.

CHRONIC SUPERFICIAL GLOSSITIS.

Chronic superficial glossitis is variously described under the names 'leucoplakia,' 'ichthyosis,' or 'smokers' patch.' The condition is not very amenable to treatment, but it is of great importance owing to the complications which may follow; the more severe forms often end in epithelioma, so that the patient must be kept under observation. The disease varies in severity, the least severe form being probably that which occurs in connection with smoking.

The condition is one of chronic inflammation of the mucous membrane of the tongue, the sub-mucous tissue being also infiltrated with cells, and the papillæ disappearing and leaving in parts smooth shiny patches which show up well on drying the tongue. The epithelium may become heaped

up on the surface in other parts of the tongue, and then the patch appears bluish or (where the epithelium is thicker) whitish, and is often indurated and fissured. The affection generally occurs between the ages of forty and fifty, and is more frequent in men than in women. It is usually attributed to long-continued irritation of the tongue. Smoking, alcohol and the irritation of carious teeth are potent factors in its production. Syphilis predisposes to it in a marked degree, and it is always well to examine the blood for the Wassermann reaction in every case that comes under notice, as the syphilitic cases are often greatly benefited by the administration of salvarsan.

The disease is very important on account of the complications which are apt to arise. Treatment has little effect, except in the earlier stages of the syphilitic cases, and the tendency is for the trouble to spread over the whole tongue; the mucous membrane of the cheek may also be affected. The patches, which at first are small and of a bluish tint, generally thicken, and in long-standing cases the condition described as 'ichthyosis linguæ' may occur, and may be accompanied by widespread cracks and fissures. After the condition has remained stationary for years, warty growths may develop, which, although non-malignant at first, are very likely to become the seat of epithelioma. In other cases, one of the fissures deepens, its edges harden, and epithelioma develops. It is on account of this great liability to the development of epithelioma that the disease is so important, for the subjective symptoms are usually slight, and in the milder cases the condition is only discovered by accident.

TREATMENT.—On account of the great risk of epithelioma in these cases, care must be taken to avoid irritation of the inflamed surface. For example, smoking, the free use of alcohol, and the consumption of very sweet or highly spiced foods should be prohibited; possibly the use of mild tobacco may be allowed to habitual smokers, but it is best to give it up completely. The diet should be regulated and any dyspeptic condition treated. All stumps, rough teeth, or badly fitting tooth-plates must be attended to, because it is generally in connection with some injury from these causes that the epitheliomatous condition arises. All patients whose blood reacts positively to the Wassermann test should at once undergo treatment by salvarsan (see Vol. I. Chap. XI.).

Caustics and irritants should be avoided, and the local treatment should consist essentially in *soothing applications.* Alkaline mouth-washes, such as bicarbonate of soda (gr. x–xv to the oz.), chlorate of potash (gr. v–xv to the oz.), and applications such as glycerinum boracis, or glycerinum acidi carbolici (diluted to 1 in 40) may give much relief. Salicylic acid and strong solutions of chromic acid cause irritation and should not be used. Butlin advocated the employment of ointments containing drugs such as borax, cocaine or morphine, in a basis of two

parts of vaseline with six of lanoline. The tongue is dried, a small portion of the ointment is laid upon it and is then rubbed in by the patient pressing the tongue against the hard palate and moving it to and fro. This method is specially indicated in those who sleep with the mouth open, and who generally suffer from a hard, dry tongue in the morning. When the condition is associated with psoriasis elsewhere, the administration of arsenic may be beneficial, but in ordinary cases of leucoplakia the drug seems to be without effect.

In bad cases—especially when an ichthyotic, or a warty or fissured condition is present—it is well to *excise the affected area* of mucous membrane. The mucous membrane alone needs removal, but it is well to employ wedge-shaped incisions, with their bases at the mucous surface; this will allow the raw surfaces to be approximated by catgut stitches inserted deeply and tied firmly so as to stop the oozing by pressure. Figs. 25 and 26, taken from the late Sir Henry Butlin's article on operations upon the tongue in the 'System of Operative Surgery,'[1] show how patches in various situations may be excised.

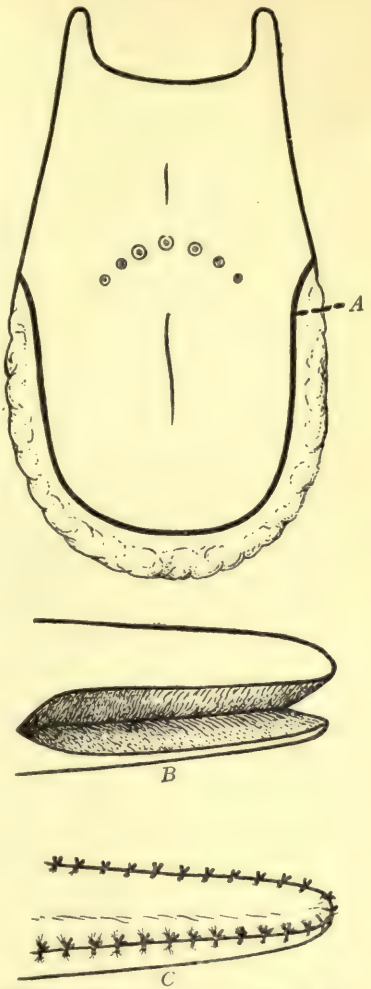
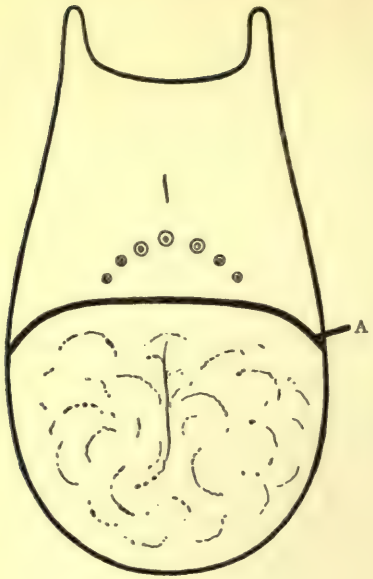


FIG. 25.—EXCISION OF AN AREA OF LEUCOPLAKIA FROM THE EDGE OF THE TONGUE. *A* shows the incision all along the edge; *B*, the appearance when the wedge-shaped portion has been removed; and *C*, that when the wound has been sutured.—*Butlin.*

Cases of leucoplakia should be seen every three or four months, with the view of keeping a watch for signs of malignant disease. It is unwise to prescribe for patients with this disease and allow them to go away under the impression that everything that is required has been done. At the same time the surgeon must be careful not to frighten the patient, and no mention of epithelioma should be made to him until its presence has been declared.

[1] *A System of Operative Surgery*, edited by F. F. Burghard, vol. ii. (London: Oxford Medical Press).



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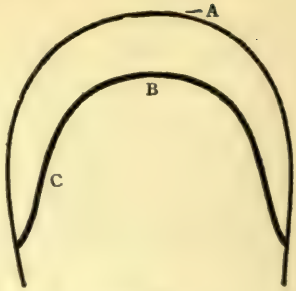

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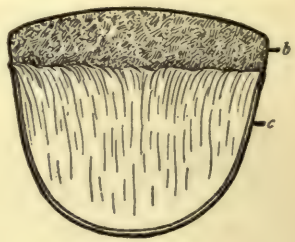

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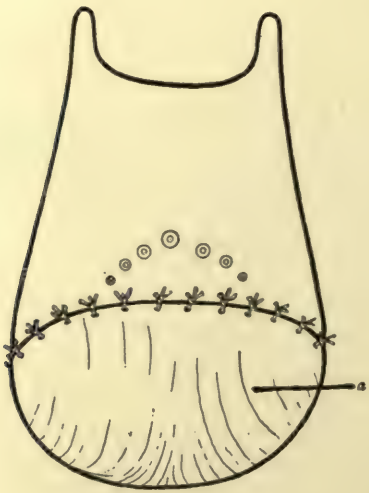

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FIG. 26.—EXCISION OF LARGE AREAS OF LEUCOPLAKIA FROM THE TONGUE.

1. The curved incision (A) across the dorsum, well behind the leucoplakic area.

2. (A) Anterior margin of the tongue; C, the incision, turning down the flap *c*.

3. Transverse section of the tongue showing (*c*) the mucous membrane of the under surface of the tongue turned down as a flap. and (*b*) the muscular fibres of the tongue cut across transversely on the level of the incision A in 1.

4. The completed operation. The flap of mucous membrane (*a*) from the under surface is brought up and sutured to the incision on the dorsum. The tongue is thus considerably shortened, but is freely movable.—*Butlin*.

SIMPLE ULCERS.

Ulcers frequently occur on the tongue, of which the most common are simple, tuberculous, syphilitic, and cancerous ulcers. Among the rarer forms may be mentioned those that occur in connection with leprosy or actinomycosis.

THE TRAUMATIC ULCER.

A common form of simple ulcer is that due to an injury such as the irritation of rough teeth. It occurs especially about the tip or borders of the tongue, and the surface of the sore is generally irregular and sharply cut, with considerable redness of the tissues around; the ulcer is often associated with dyspepsia.

TREATMENT.—The first thing is to *ascertain the cause and remove it.* Any carious teeth should be filed and stopped, or removed. In elderly subjects they should be extracted at once, if there is any reason to doubt that milder measures will be successful. The mouth must be cleansed, the remaining teeth scaled and cleaned, and a mouth-wash of sanitas or weak glycerine and borax employed at frequent intervals. If the ulcer does not heal at once, it may be painted once or twice daily with a 2 per cent. solution of chromic acid. At the same time attention must be paid to the state of the bowels, and any dyspepsia treated. The exquisite pain met with in these cases may prevent the patient from eating; the application of a 5 per cent. solution of cocaine to the surface of the sore immediately before a meal will enable food to be masticated in comfort; orthoform dusted over the surface a short time previously secures a more prolonged relief from the pain and is not poisonous. If the ulcer refuses to heal in spite of treatment, it is well to examine a portion microscopically, or, if it is small, to excise it completely in order to make sure that the case is not one of commencing epithelioma. Care must be taken that the section goes beyond the edge and the base of the ulcer.

THE DYSPEPTIC ULCER.

Ulcers occurring in connection with dyspepsia are often spoken of as 'dyspeptic ulcers,' although their exact relation to the stomachic condition is not clear. These ulcers are generally situated about the tip of the tongue or on the dorsum near the tip, but they may appear on the inner surface of the cheek, and they are usually exquisitely tender. In addition to the ulcer there is often an irritable condition of the tongue in the neighbourhood, and the organ is generally thickly furred. In some dyspeptics there may be a superficial glossitis, without actual ulceration, which causes much discomfort, smarting and burning.

TREATMENT.—When the ulcer is due solely to dyspepsia, the

latter condition must receive the treatment appropriate to the particular form present. The most useful drugs are bismuth, bicarbonate of soda, rhubarb, and gentian; but of course these must be varied according to the essential nature of the disease, and the diet must be regulated accordingly: the food should be soft and non-irritating. It is well to clear out the bowels in the first instance and to see that they are moved daily.

In the *local treatment* frequent cleansing of the mouth with gargles of sanitas, chlorate of potash, or boro-glyceride will be necessary. If the ulcers are painful, touching them occasionally with 2 per cent. solution of chromic acid, or with nitrate of silver fused on the point of a probe, will often give relief. If healing is slow, astringent lotions such as weak solutions of alum (gr. ij–v to the oz.) may be employed, and iron should be administered internally in the form of pil. ferri (gr. v–xv t.d.s.) or syrup of the iodide of iron (℥ss–℥j). The teeth should be attended to, and if there is any pyorrhœa present it must be treated.

THE LEUCOPLAKIAL ULCER.

It is not uncommon for ulceration to occur about the centre of leucoplakial patches in cases of chronic superficial glossitis. The ulcers are usually very sensitive and difficult to get rid of. They generally take the form of fissures of varying depth, in which epithelioma is prone to develop. These ulcers are difficult to treat, and often remain unhealed for a long time; owing to the thickness of the tissues around, they may present all the appearances of a callous ulcer.

TREATMENT.—All causes of irritation must be removed, and antiseptic and astringent mouth-washes, such as alum or tannin (gr. ij–v to the oz.), should be employed. In patients under middle age, a solution of chromic acid (commencing with 2 per cent. and increasing up to 10 per cent.) may be painted on the ulcer once daily. In chronic cases it is best to excise the ulcer as soon as it is found that it will not heal under careful treatment. When the sore is the centre of a limited patch of leucoma, excision of the entire patch along with the ulcer is advisable, and should be done in the manner described for leucoplakia (see p. 59).

THE MERCURIAL ULCER.

This is merely an exaggerated stage of mercurial stomatitis, and is rarely seen nowadays; it was fairly common formerly and resulted from an unduly free use of mercury.

TREATMENT.—The immediate disuse of the drug is obviously called for, whether it has been given internally for syphilis or whether the affection occurs in a patient working with mercury. A course of saline

aperients should be given, and a mixture containing 10–15 grains of chlorate of potash should be administered three times a day. At the same time careful attention to the hygiene of the mouth is essential, the teeth being frequently cleansed with a tooth-powder containing chlorate of potash, carbolic acid, and some astringent, such as catechu.

CHAPTER VII.

SYPHILIS AND TUBERCULOSIS OF THE TONGUE.

SYPHILIS.

LINGUAL syphilis is very common, and all stages of the disease may be met with.

A primary chancre is rare on the tongue ; when it affects the mouth it generally occurs on the lip or in the region of the tonsil. On the tongue it is usually situated towards the tip or the anterior part of the dorsum.

Mucous patches are extremely common in the course of secondary syphilis, and may be met with on any part of the tongue, most frequently about its borders. They may occur also in the congenital form of the disease and are usually multiple and accompanied by other manifestations of the disease elsewhere. The patches vary in appearance according to their situation ; on the side of the tongue, they form elongated or oval areas and are often fissured or ulcerated in the centre and very painful ; on the dorsum the ulceration is not so marked, and the patch is generally smooth, with whitish margins ; on the under surface of the tongue they may present the warty appearance of the typical mucous patch.

In tertiary syphilis *sclerosing glossitis* (localised areas of inflammation with thickening of the tissues beneath) or typical *gummata* may be met with. The first form causes deep fissures and ulcers on the tongue which are very typical. In the earlier stages they give rise to thickened patches of variable size with a white appearance, which somewhat resemble leucoplakia ; these areas are often fissured or ulcerated.

The most frequent form of tertiary lesion is a *gumma.* Gummata occur either on the surface of the tongue or deep in the muscular tissue ; the more deeply seated forms are usually near the middle line. They may be single or multiple, and gradually break down and lead to a comparatively deep conical ulcer, with a foul sloughy surface, and without the hard everted edge that is typical of epithelioma. There is often

considerable induration about the ulcer, especially when the latter has existed for some time, and it is not always easy to make a diagnosis between it and the cancerous form; indeed epithelioma not infrequently develops in these ulcers.

TREATMENT.—*In the primary and secondary stages* the general treatment for syphilis (see Vol. I. Chap. XI.) must be employed; for mucous tubercles, the local application of calomel is also valuable. In applying calomel the tongue should be held out of the mouth and dried, and the surface of the ulcer lightly dusted with a powder composed of equal parts of calomel, boric acid, and starch; this should be done twice or thrice daily.

The *secondary ulcerations* are often very painful, and the pain is best relieved by the occasional application of solid nitrate of silver. In obstinate cases, painting the affected area over once or twice a day with a 10 per cent. solution of chromic acid is of service. The patient should only take soft food, and must avoid smoking and the use of anything acid or very hot or cold. In cases marked by excessive pain which renders sleep and feeding matters of the greatest difficulty, the patient will go downhill, unless he is brought rapidly under the influence of antisyphilitic remedies; salvarsan should be employed, or failing that the intra-muscular injections of mercury (see Vol. I. Chap. XI.). The local application of orthoform or cocaine (5 per cent.) to the affected spot is sometimes useful, by enabling the patient to take food in comfort.

In treating the *tertiary ulcers*, the chief reliance must be placed upon the use of salvarsan, as it is most essential to get rapid healing, especially in view of the risk of malignant disease; should this drug not be available, recourse must be had to the administration of iodide of potassium internally in large doses, commencing with 15 grains and rapidly increasing to 30 grains or even more, three times a day; it is well to combine the use of this drug with mercurial treatment. Local applications should be limited to mild antiseptic mouth-washes. Tobacco, alcohol and highly spiced and acid articles of diet should be forbidden. Rough teeth should be filed, stumps removed, tartar taken away, and the teeth kept clean. When there is a deep ulcerated crack in the tongue, equal parts of balsam of Peru and white of egg may be painted on several times a day with a camel's-hair brush, and an alkaline mouth-wash, such as bicarbonate of soda (gr. xv–xx to the oz.) may be used.

The most important cases are those in which the ulcer has lasted for some time and induration is developing about the edges. These cases are extremely difficult to diagnose from epithelioma. An early diagnosis can only be made by the microscope, and therefore, a portion of the edge and base of the ulcer should be excised and submitted to microscopical examination. If the surgeon attempts to make up his mind from the results of anti-syphilitic treatment, at least two or three weeks must

elapse before the diagnosis is certain, and time is of such great importance in these cases that the most rapid and certain means of coming to a decision must be employed.

TUBERCULOSIS.

This condition closely resembles that occurring on the lower lip (see Vol. III. p. 463). The ulcers may be primary, or secondary to tuberculous disease elsewhere; the primary form is extremely rare. In most cases ulceration occurs in the subjects of phthisis or of tuberculosis of the larynx or pharynx, and is usually connected with some injury, such as the irritation of a rough tooth.

The ulcers are extremely painful, and may give rise to great difficulty in eating and swallowing. They usually occur about the tip of the tongue, although they may appear on the dorsum farther back. They vary from a crack at the tip of the tongue with hard edges—on separating which a deep fissure may be found—to a superficial erosion beginning as a small vesicle. As the ulcer increases in size, it becomes irregular in shape, and its surface is pale and flabby, and generally covered with yellowish grey mucus. The edges are not much undermined; they are often sharply cut and redder than the surrounding parts. The ulcer is superficial at first, but extends more deeply as it increases in size. The tongue is generally swollen.

TREATMENT.—Radical measures are indicated when the ulcer is small, single, and unaccompanied by advanced tuberculous disease elsewhere, and they are especially applicable in the case of the ulcers on the tip of the tongue, which cause intense pain on mastication or articulation. The more extensive tuberculous ulcers, associated with similar disease in the larynx or lungs, should, however, not be excised unless they are causing great pain; excision would mean an extensive operation, whilst the cut surface would be liable to become infected. When, however, the disease in the lungs is quiescent, it is of advantage to remove the ulcer, even though it be extensive. The ulcers should not be excised when they occur in the neighbourhood of the base of the tongue.

The best method of removing the ulcer is by a wedge-shaped excision, the cut edges being accurately stitched together afterwards. It is useless to excise the ulcers and to leave a raw surface, as re-infection would almost certainly occur. The operation is described on p. 59. The hygiene of the mouth should be attended to before it is undertaken. Afterwards antiseptic mouth-washes should be employed.

When a radical operation is not advisable, an attempt may be made to remove the infected surface of the ulcer, but in many cases it will be necessary to be content with measures designed merely to relieve the pain and inconvenience in mastication and articulation. Unless the patient is profoundly ill, it is best to remove the surface of the ulcer,

and this may be done without a general anæsthetic, although the use of one is more satisfactory. The ulcer is mopped over with a 10 per cent. solution of cocaine (to which a few drops of adrenalin chloride are added), and its surface is carefully scraped with a small sharp spoon, and afterwards sponged over with undiluted carbolic or lactic acid (see Vol. III. p. 463). This may be repeated if necessary at intervals until healthy granulation occurs. A mouth-wash of boro-glyceride or sanitas may be used after the operation; one of alum or tannin (gr. ij–v to the oz.) should be substituted if healing is slow. The constitutional treatment of tuberculous disease (see Vol. I. p. 231) should be carried out.

When the ulcer is too extensive or the patient is too weak for this treatment, the surface of the ulcer may be painted over with a 20 per cent. solution of lactic acid every alternate day. If the pain is very severe orthoform may be powdered on the ulcer shortly before meals, so as to relieve the pain. Should this fail, the local application of a 10 per cent. solution of cocaine should be prescribed. As an alternative in severe cases, a sixth of a grain of morphine mixed with a little boric acid may be dusted on the ulcer after its surface has been dried.

CHAPTER VIII.

NON-MALIGNANT TUMOURS OF THE TONGUE.

SIMPLE tumours of the tongue are rare. *Lipomata* and *fibromata* are sometimes met with and must be enucleated if the diagnosis is made; in a doubtful case it is advisable to cut down and ascertain the nature of the growth before performing a set excision, as the simple removal of a non-malignant tumour will suffice for a cure.

NÆVUS.

Nævus of the tongue may be either *capillary* or *venous*; it is usually unilateral. These tumours may not give rise to any trouble if they are small, the chief accident to which the patient is liable being hæmorrhage if the growth is injured; septic thrombosis may follow the injury. When, however, a venous nævus affects a considerable area of the tongue and increases in size, great enlargement of the organ ensues and the tongue constantly gets in the way of the teeth and is wounded, the patient being thus exposed to the risk of serious hæmorrhage and septic infection.

TREATMENT.—This must vary with the extent and progress of the affection and also with its situation. *When the nævus is stationary and is situated on the dorsum*, there is rarely any need for operative interference. The tumour should be watched, and should only be operated upon if it increases in size. Should it do so, the best plan, when the growth is quite small, is to destroy it with the actual cautery at a dull red heat so as to sear the vessels and not to cut through them.

When the nævus is on the side of the tongue and is small, it is liable to be bitten and it should be excised, even though it may not be increasing in size. This can be done by a wedge-shaped incision so planned as to go well clear of the dilated vessels. A few ligatures may be required, but as a rule the hæmorrhage soon ceases when the sides of the wedge are brought together by catgut sutures inserted deeply. Before inserting the

stitches the surface may be sponged with adrenalin chloride (1 in 1000). Should it be impossible to control the bleeding in this way, the raw surface may be seared with the actual cautery, but if possible this should be avoided because it interferes with rapid healing. If the incision is carried wide of the nævoid tissue, however, the bleeding is generally trifling.

The serious cases are the *extensive venous nævi* which lead to steady increase in the size of the tongue ; in them treatment is necessary on account of the liability of the organ to injury. Here the only satisfactory method is excision ; other methods, such as electrolysis, are inadmissible because of the great danger of septic thrombosis and pyæmia resulting from sepsis spreading along the needle-tracks ; electrolysis is also a tedious and uncertain method. A considerable portion of the tongue may have to be removed, and it is well to perform a preliminary ligature of one or both of the lingual arteries according to the size of the tumour. This is done as follows :—

Ligature of the lingual artery.—The spot chosen for tying the vessel in continuity is just after it passes beneath the hyoglossus muscle. The head is extended upon a sand-bag and turned to the opposite side, with the chin pointing upwards. A curved incision is carried from just below and outside the symphysis downwards to the body of the hyoid bone, and then upwards again nearly to the level of, but a little behind, the angle of the jaw. The lower part of the incision is deepened until the fascia covering the submaxillary salivary gland is reached, and this fascia is incised along the lower edge of the gland and the latter raised out of its bed along with the skin-flap and pulled well up on to the cheek, where it may be secured by a stitch. When the flap has been raised, the posterior edge of the mylohyoid muscle is seen in front and the posterior belly of the digastric behind. The anterior belly of the latter muscle with the intervening tendon is also seen, and should be pulled firmly downwards ; this will show the fibres of the hyoglossus muscle deep in the wound. The hypoglossal nerve is seen crossing the hyoglossus horizontally and parallel to, but a little above, the hyoid bone. The lingual artery lies beneath the fibres of the muscle between the nerve and the bone. Slightly below the nerve and superficial to the hyoglossus is the lingual vein. Vein and nerve are now pulled upwards, and a transverse incision about half an inch in length is made parallel to the hyoid bone and just above it, and the artery thus exposed. This incision must be made with care, otherwise the pharynx may be opened. The artery is isolated, and an aneurysm needle passed around it from above downwards.

Care must be taken to define and raise the submaxillary gland efficiently but without injuring it, otherwise a salivary fistula may result. The chief difficulty of the operation lies in finding the vessel beneath the hyoglossus. If the operator fails to find it there, he may trace the

hypoglossal nerve backwards ; this will bring him to the external carotid artery from which the lingual artery arises.

In spite of preliminary ligature of the lingual, however, the bleeding during the removal of the nævus may be profuse, so that, in very extensive cases, it is well to control the circulation by temporary ligatures passed through the substance of the tongue well beyond the area of excision. After the nævus has been removed and the larger vessels have been tied, oozing is arrested by the sutures which bring the edges together and which should be inserted deeply through the wound and tied firmly. Occasionally, however, it may be found necessary to apply the actual cautery before the temporary ligatures are removed.

LYMPHANGIOMA.

This is the usual cause of the condition known as '*macroglossia*' the typical form being a congenital lymphangioma of the tongue. The superficial vessels are usually dilated and tortuous and give rise to vesicles on the surface of the organ towards the tip and edges. At first the tongue is soft and does not cause much inconvenience, although it occasionally swells and becomes inconveniently large. The superficial dilated lymphatics are easily injured, and injury may be followed by inflammation of the tongue and considerable thickening ; as a result the tongue is liable to repeated inflammatory attacks which leave the organ firmer, harder and larger than before. After a time the tongue may become too large for the mouth and be firmly pressed against the teeth of the lower jaw ; it may even hang out of the mouth permanently. As a result, the pressure on the lower jaw causes the alveolar border and the teeth to project forwards, and this deformity becomes irremediable if it is allowed to persist. The patient may also suffer from difficulty in breathing, masticating and swallowing. A similar condition may be met with in von Recklinghausen's disease.

TREATMENT.—In former days, ignipuncture, electrolysis, or scarifications were employed, but they never cure the condition, and only serve to set up inflammation and increase the growth of the tongue. The only method which promises success is *excision of wedge-shaped portions* of the organ including as much as possible of the lymphangiomatous mass. These operations are no doubt dangerous and may be followed by severe lymphangitis, just as are operations for hydrocele of the neck and other lymphangiomatous tumours. When, however, repeated attacks of inflammation have occurred and a typical macroglossia has been produced, the lymphatics are widely blocked already and there is not the same risk of spreading lymphangitis. Notwithstanding this risk the condition of the tongue is far too serious to be left alone.

Before operation the mouth must be cleansed, all fur removed from the tongue, and the teeth scaled and cleaned. A wedge-shaped portion

of the tongue, so planned as to include the greater part or the whole of the lymphangiomatous region and to reduce the size of the organ to its proper limits, should be removed ; this should be done before deformity of the jaw has occurred. The bleeding generally stops when the edges are brought together ; persistent oozing may be checked by the application of adrenalin chloride (1 in 1000). The edges of the wound are then brought together by catgut sutures inserted deeply, and a mouth-wash of boro-glyceride or sanitas is used.

LINGUAL GOÎTRE (THYREO-GLOSSAL TUMOURS).

In connection with the thyreo-glossal duct which runs from the isthmus of the thyroid gland to the foramen cæcum of the tongue, tumours of varying sizes are occasionally found, which consist of thyroid tissue and have received the name of lingual goître. Sometimes they form small tumours about the size of a cherry in the region of the foramen cæcum, sometimes they press back the epiglottis and give rise to dysphagia, and occasionally the tumour projecting from the base of the tongue is connected along the middle line of the organ with another projecting in the neck over the centre of the hyoid bone.

The chief symptoms to which these tumours give rise are those of difficulty in deglutition and articulation. They are also liable to sudden variations in size owing to hæmorrhage into their substance, and their vascularity is such that they may give rise to alarmingly severe bleeding if they are wounded. In several of the recorded cases the normal thyroid gland has been absent.

TREATMENT.—For two reasons this should not be undertaken unless the size of the swelling renders it imperative. In the first place profuse hæmorrhage may occur during the operation in spite of the greatest care, and in the second place, myxœdema may follow their complete removal. Operation must be undertaken, however, if deglutition, respiration, or articulation are much interfered with, and it seems to be agreed that the best way to remove these tumours is by means of the galvano-cautery. A 10 per cent. solution of cocaine, to which a few drops of adrenalin chloride (1 in 1000) are added, is applied to the affected area upon a cotton-wool mop, and then, by the aid of the laryngeal mirror, the loop of the galvano-cautery is slipped over the tumour and made to surround its base. On no account must the cautery be used too hot, neither must it be tightened up too quickly ; if it is, serious bleeding may occur. This procedure only cuts off the projecting portion of the tumour flush with the surface of the tongue, but published cases show that this is sufficient, and it has the great advantage that the surgeon knows that he has left some active thyroid tissue behind.

Should it be necessary to remove the tumour entirely, as may be the

case if it extends deeply into the base of the tongue and gives rise to much enlargement there, it will be advisable to give the patient a general anæsthetic, and then either perform a preliminary laryngotomy and plug the pharynx, or have the head hanging well down so that any blood will collect in the naso-pharynx. The tongue is pulled well forwards by means of a clip or tongue-forceps, and an elliptical incision is made through the mucous membrane of the tongue enclosing the base of the tumour, but not incising it. Good reflected light or a powerful forehead lamp is required, as the tumour must not be injured. Then, with a blunt dissector, the growth can be shelled out without serious bleeding, and the cavity which is left should be obliterated by a few catgut sutures inserted deeply so as to arrest bleeding and secure coaptation.

Should myxœdema ensue, the patient must be treated by means of thyroid extract (see Vol. V.).

PAPILLOMATA.

Warts are not uncommon on the tongue, and are important mainly because they may be followed by epithelioma. They are usually pedunculated and occur on the dorsum ; they may also be met with beneath the tongue in the neighbourhood of the frenum. The warty condition of the tongue associated with leucoma is referred to on p. 58 ; in that condition the warts are usually sessile and are very liable to be followed by epithelioma.

TREATMENT.—Removal is imperative and is usually easy. The best method is to enclose the base of the wart in an elliptical incision carried into the substance of the tongue in a wedge-shaped manner, so as to allow the edges of the wound to be stitched together with catgut afterwards. This operation is best performed under general anæsthesia, but local anæsthesia by cocaine, applied both locally to the surface and injected into the tongue, may be employed ; the objection to it is the difficulty of controlling the movements of the tongue.

CHAPTER IX.

MALIGNANT DISEASE OF THE TONGUE.

SARCOMA.

SARCOMA has been met with in the tongue both as a primary and a secondary growth, but it is exceedingly rare ; its treatment is similar to that of sarcoma elsewhere.

EPITHELIOMA.

This is the most important disease of the tongue, and the results after removal are particularly unfavourable. It is much more common in males than in females. The most usual seat of the growth is the middle and anterior part of the edge of the tongue, but it is not uncommon towards the base, and is often an extension from the tonsil, the fauces, or the pharynx.

Of the *causation* of lingual cancer, nothing more is known than that of cancer in general. Here, as elsewhere, it is ascribed to some form of irritation, and there is no question that a rough tooth is a common exciting cause in a patient predisposed to cancer. It is also often attributed to smoking, but while the constant irritation of tobacco in a susceptible subject may play some part, we are inclined to think that its rôle has been exaggerated.

Epithelioma of the tongue varies in its characters in different cases. In the majority, it is a rapidly growing and very malignant tumour. It may occur as a crack or fissure with hard edges, or as a prominent sore on the tongue without any deep ulceration or marked outgrowth. In other cases it may begin as a warty mass with a hard base and edges, which increases and forms a cauliflowerlike excrescence yielding a foul discharge and characterised by deep ulcerations and fissures in the clefts between the papillomatous prominences. Much more rarely the tongue becomes

indurated without any marked ulceration and without being warty, and the disease progresses slowly and resembles in its characters the atrophic scirrhus of the breast.

The cancer is at first superficial and the patient's attention may only be drawn to it by some slight pain or interference with mastication or articulation. The disease spreads not only superficially along the mucous membrane, but also deeply into the muscles, and before long this leads to difficulty in protruding the organ ; this is most marked when the disease occurs far back.

When the growth is situated on the edge of the tongue or floor of the mouth, it spreads not only on to the dorsum, but also, and often chiefly, along the floor of the mouth and thence to the mucous membrane covering the lower jaw, the periosteum and bone being soon affected.

When situated at the back of the tongue, the growth spreads to the mucous membrane of the floor of the mouth, to the tonsil and anterior pillar of the fauces, the pharynx, and the orifice of the larynx, and upwards on to the soft palate ; so that in cases of extensive cancer of the base of the tongue there may also be disease of the tonsil, fauces, and soft palate. In other cases the disease in the tongue in this situation is secondary to a primary focus in the palatal or tonsillar regions.

When the growth spreads from the tongue to the floor of the mouth or commences in the latter situation, it affects the lymphatic glands early, and the sublingual salivary glands also become infiltrated. Removal of the tongue alone, even at a very early stage, seldom arrests the disease altogether. It may not recur in the mouth, but it almost invariably does so in the neighbouring lymphatic glands.

The greater severity of the disease when it occurs in the tongue may be partly due to great suitability of the soil for the growth of epithelium, but is also partly the result of the early infiltration of the lingual muscles. When cancer attacks a muscle it soon becomes diffusely distributed over it by way of the lymphatic vessels as a consequence of the muscular movements. In cancer affecting the side of the tongue, the hyoglossus is liable to early infiltration, while in the more centrally and deeply situated growths, it is the genio-hyoglossus that is most involved. This point has a most important bearing on the extent of the operation necessary in these cases, and more especially on the question of partial operations.

The lymphatic glands first affected vary according to the seat of the primary disease in the tongue. In *cancer of the tip, the frenum and the anterior part of the floor of the mouth,* the submental glands are first affected, and after them those in the submaxillary region. In *cancer of the middle of the tongue and floor of the mouth,* the glands in the submaxillary region will generally be first enlarged. The submaxillary salivary gland itself usually escapes, but there are lymphatic glands in intimate connection with it which soon become enlarged. The disease

spreads from the submaxillary glands to those in the anterior triangle, especially in the neighbourhood of the bifurcation of the carotid artery; sometimes it may skip the submaxillary region altogether and appear first in the anterior triangle. Here it spreads rapidly from gland to gland, upwards along the carotid sheath as high as the parotid region, downwards towards the root of the neck and backwards in the glands under the upper half of the sterno-mastoid muscle into the posterior triangle. *In cancer of the back of the tongue and the tonsillar region*, the disease first affects the deep glands in the neighbourhood of the digastric muscle and thence spreads upwards to the glands in the parotid region, downwards to those along the sheath of the vessels and backwards to those beneath the sterno-mastoid.

The rapid distribution of the disease over the whole of these lymphatic areas is an extremely important point to bear in mind in treatment, because mere excision of the enlarged lymphatic mass will almost invariably be followed by recurrence, and in most operations it is not sufficient to remove the chain of glands lying along the carotid; those under the sterno-mastoid must always be removed, especially the group beneath the upper end extending as far up as the mastoid process and as far back as the posterior triangle. Another most important point in the operative treatment is that the affected glands are soft and very easily torn, and, until they are examined microscopically, the epitheliomatous disease in them may not be recognisable. If they are roughly handled, they readily tear across, and if this occurs during removal there may be an infection of the surface of the wound, leading to a rapid diffuse epitheliomatous infiltration of the whole area of the operation. The glands become hard as they enlarge, but when they have attained a large size they tend to soften and break down in the centre, so that fluctuation may be obtained. Mistakes have been sometimes made for this reason, and the glands have been opened under the impression that they were suppurating, with the result that an epitheliomatous ulceration of the skin has followed. Cystic degeneration of epitheliomatous glands is common, and must be borne in mind during operation, for if such a gland be torn or punctured and the fluid contents escape into the wound, a diffuse epitheliomatous infiltration may follow, for which further operation is impossible.

SYMPTOMS.—Apart from its well-known local characters the growth soon gives rise to difficulty in articulation and mastication, dysphagia and excessive salivation, and the discharge in the mouth is very foul. The pain is usually intense towards the later stages; it is generally referred to the ear, but any of the branches of the third division of the fifth nerve may be affected and it is not only present on eating and speaking, but also when the tongue is at rest.

The disease in the glands usually progresses rapidly, and, if the patient lives long enough, they may fungate through the skin, which then becomes

the seat of epitheliomatous ulceration. Bleeding is common from these deep ulcers, and may be severe.

In the case of patients who have not been operated upon, the disease generally causes death within a year, or at the most within eighteen months. The cause of death is usually exhaustion due to gradual emaciation, profuse discharge and hæmorrhage from the ulcer, and difficulty in taking food. The final result is often brought about by a low form of pneumonia. Occasionally there are profuse hæmorrhages from the ulcer in the mouth or in the neck, but as a rule the hæmorrhage is not severe, and only contributes indirectly to the death of the patient.

TREATMENT.—The first and most important point in the treatment is to decide which cases are operable and which are not. The growth in the mouth should always be removed when it is possible to do so, because even though recurrence should take place in the glands, the termination will be much more easy if the mouth remains free from disease.

The choice of cases for operation. — The chief points which determine the suitability of any given case for operative treatment are the extent and situation of the growth in the mouth, the degree of implication of the glands in the neck and the general condition of the patient. We shall consider these questions in the above order.

The extent of the disease in the mouth only influences the question in so far as the possibility of complete removal of the primary disease is concerned. When we consider the sufferings which a patient dying from cancer of the tongue has to undergo, sufferings which are largely attributable to the foul mass in the mouth, it is obviously the surgeon's duty to attempt the removal of the primary growth, even when the area of healthy tissues around the disease is comparatively slight, and when therefore there is a considerable risk of recurrence. This argument must not, however, be carried too far, for there can be no object in cutting into the mouth when the disease is so extensive that it is obviously impossible to remove it entirely. For instance, if the tongue is infiltrated with cancer which has extended so far on to the floor of the mouth as to fix the organ, no good can result from operation, seeing that only a portion of the growth can be taken away.

The situation of the disease in the tongue is of importance. A comparatively extensive growth situated on the anterior part of the organ may be removed with a fair prospect of success when a much less extensive mass in the posterior half should be left alone. Some surgeons hold that extension of the disease from the tongue to the tonsillar region contraindicates operative interference, but, although it undoubtedly increases the gravity of the operation, we are not inclined to look upon these cases as necessarily inoperable. We have operated on cases in which the growth extended on to the soft palate and the pharynx, and have been able to remove the disease completely. If, however, the whole base of the tongue is involved and the mischief extends across the middle line, the

case is undoubtedly better left alone. We would say that when the growth is situated in the base of the tongue, it should be regarded as inoperable, unless it is limited to one side, and is situated well towards the edge. Removal of the entire tongue is a very serious operation and is very liable to be followed by fatal septic complications. In feeble patients, indeed, death may occur from shock at the time of the operation.

When the disease involves the orifice of the larynx, particularly the aryteno-epiglottidean fold, operation is contra-indicated. On the other hand, limited epithelioma on the back of the tongue involving the upper surface of the epiglottis may be removed. When the growth on the tongue is so extensive as to necessitate removal of a portion of the aryteno-epiglottidean fold, the disease will have spread, to some extent at any rate, into the tonsillar region and the pharynx, and removal would leave a large raw surface, the discharges from which will find their way directly into the larynx, so that death from septic pneumonia or acute septicæmia will almost certainly occur. The only logical operative possibility here would be to remove both the tongue and the larynx, which is a very severe mutilation and one to which few patients would submit. Extension to the jaw, particularly in the region of the angle, also renders the case inoperable in most instances. If the disease is in the anterior portion of the tongue, extension to the jaw is not, however, necessarily a contra-indication, provided that the involvement is only limited.

When the glands in the neck become involved, the disease in them is much more extensive than in the tongue, and it is not at all uncommon to find cases regarded as inoperable on account of the glandular infection, although the disease in the tongue could be easily removed. Until recently, surgeons have not been nearly bold enough in the removal of epitheliomatous glands from the neck. It has been customary to teach that glands should not be removed unless they are small and freely movable, and that fixation is a contra-indication to removal. Experience has convinced us, however, that this is too sweeping a statement. Fixation of the glands in the early stage simply means that they are adherent to the carotid sheath, and the limitation of movement is only in the vertical direction. Numerous operations, both on tuberculous and malignant glands, have shown us that this adhesion to the carotid sheath does not materially complicate the operation for removal of the glands. If the internal jugular vein, or sometimes merely the overlying portion of its sheath, be removed systematically in all these cases, the glands can be taken away completely. Excision of the vein does not apparently affect the comfort or safety of the patient in any way. The serious difficulty arises when the glands involve the carotid artery, the vagus nerve, or both, and under these circumstances the condition may well be looked upon as inoperable. But however fixed the glands appear to be when examined through the skin, it will be found that as long as there is lateral mobility, removal of the jugular vein almost always suffices to

permit complete extirpation, and therefore it is important to cut down and ascertain the exact condition of affairs under these circumstances. A comparatively slight dissection will show whether removal is feasible or not, and, if the case is found to be inoperable, the wound can be closed without risk to the patient. Involvement of the carotid artery and the vagus nerve are rare except when there is extensive infiltration of the neck—when the mass will be completely fixed and there will be no lateral mobility—and ligature of the carotid artery with its serious symptoms due to imperfect blood-supply to the brain will therefore practically never be called for. Removal of portions of the vagus, on the other hand, does not seem to be attended by any particular danger. It has been done more than once accidentally, and in one case in which we found the carotid artery unaffected, but the vagus infiltrated with disease, two inches of the nerve were removed designedly, and the patient was none the worse. If, however, the disease involves the artery, we should consider the case inoperable.

Should there be extensive involvement of the glands extending well down into the root of the neck, so that it is obvious that those in the thorax must also be affected, or should the glandular enlargement infiltrate the skin, thereby showing that the disease has passed beyond the limits of the gland, operation must be looked upon as out of the question.

Extension of glandular disease beneath the sterno-mastoid muscle, although it makes complete removal more difficult, does not necessarily contra-indicate operation. On the other hand, extension upwards into the parotid region is a much more serious matter, inasmuch as, owing to the anatomical conditions, the chances of removing all the affected glands are very slight.

The general condition of the patient will influence the decision to some extent. It is rare for metastasis to occur in cancer of the tongue, although secondary deposits have been found in the lung and liver. Either the disease does not spread by the blood-vessels or else the patient dies before it has had time to establish itself elsewhere; the presence or absence of metastatic deposits therefore does not, as a rule, affect the question of operation. But after operation for cancer of the tongue, a wound is left which must become septic, and the chances of recovery must depend, to a great extent, on the patient's power of resisting septic infection, and therefore his general state of health is a matter of great importance. Alcoholics, for instance, stand these operations badly, particularly when the area involved is the base of the tongue, and it is not advisable to undertake extensive operations in habitual drunkards, even though they have no albuminuria or definite visceral disease. The operation is frequently followed by an attack of delirium tremens, and, moreover, the tissues of these patients seem peculiarly unable to resist sepsis, so that the chances of a fatal result are great. There would be the same hesitation in operating upon the subjects of albuminuria or diabetes.

Patients who are very feeble and much run down by the disease, or semi-starved, will not stand an extensive operation, such as removal of a growth from the base of the tongue or excision of the entire organ, at all well; they are extremely liable to succumb, especially to septic or hypostatic pneumonia. In these individuals, therefore, the disease should be left alone, unless it is small, favourably situated, and entails only a comparatively slight operation. On the other hand, in the case of strong, robust men, it is often well to give them the chance, even when the disease is extensive. These patients generally stand the shock of the operation perfectly well, and the result depends chiefly upon the question of sepsis. As our experience has increased, we have found that these risks may be diminished in various ways.

Dangers of the operation and the best means of avoiding them.—These dangers may be immediate or remote, the former being shock, hæmorrhage, and asphyxia from blood passing into the air-passages, whilst the latter are largely due to sepsis, such as septic pneumonia, acute septicæmia, suppuration among the planes of cellular tissue in the neck, and secondary hæmorrhage.

Immediate dangers.—*Shock* has to be guarded against on the lines indicated in Vol. I. p. 117. The occurrence of shock depends, to a great extent, on the physical condition of the patient. The method of inducing anæsthesia and the anæsthetic employed are also of importance with regard to this question. When much shock is anticipated, the intravenous method of administering anæsthetics (see p. 32) may be of advantage, as the continuous administration of saline solution intravenously during the operation is a powerful factor in reducing shock, provided the amount introduced is moderate.

The prevention of *hæmorrhage* during the operation will be considered in connection with the technique of the operation itself. The chief point is whether a preliminary ligature of the lingual arteries (see p. 69) should be performed, or whether the vessels should be caught and tied in the mouth during the removal of the tongue. The answer depends chiefly on whether the wound made for ligature of the artery will communicate with the mouth or not; if it does, the wound becomes septic and secondary hæmorrhage is very apt to occur. When the neck has to be opened up for the removal of enlarged glands, which should be done, if possible, before the disease in the mouth is attacked, the lingual artery can be readily tied at the same time and this shortens the subsequent operation on the tongue and diminishes the bleeding into the mouth, and thus in both ways reduces the shock of the operation. Hence, when the removal of the disease from the tongue and the glands is carried out in two stages—the removal of the glands preceding the operation upon the tongue by some days—the lingual artery should be tied at the first operation.

On the other hand, when an extensive operation in the anterior triangle is necessary and must be done at the same time as the operation

on the tongue, and when consequently this wound communicates freely with the mouth, we prefer to ligature the lingual artery as it is divided in the tongue, because the whole wound in the neck must necessarily become septic, and the ligature on the lingual trunk near its origin from the carotid is certain to separate, and its separation is likely to be followed by secondary hæmorrhage. This occurs usually about the tenth day, when the patient is otherwise fairly well and is probably not under careful supervision, and he may die before assistance can reach him, death ensuing either from loss of blood or from the blood finding its way into the trachea. In order to stop the hæmorrhage it will be necessary to tie the external or the common carotid arteries, either of which operations may be followed by disastrous results—the ligature of the external carotid probably by secondary hæmorrhage, as it will be tied in a septic wound, and ligature of the common trunk by fatal cerebral symptoms. Under these circumstances, therefore, we prefer to tie the terminal branches of the vessel rather than to ligature it in continuity at its origin.

Asphyxia from the passage of blood into the trachea is usually comparatively easily avoided. The patient should lie with the face turned a little towards the sound side, the lower angle of the mouth being firmly pressed down by an assistant's fingers so that the blood runs first into the hollow of the cheek and then out of the mouth. Some surgeons, however, raise the head and shoulders of the patient, and throw the head forwards, so that the blood shall run directly out of the mouth. This risk may be altogether avoided by performing a preliminary laryngotomy (see p. 33) and plugging the pharynx firmly with a large sponge attached to a long tape, the end of which hangs out of the mouth and is secured by forceps. This operation does not materially increase the risks, and has the great advantage of enabling the surgeon to disregard the oozing and to concentrate his attention entirely on the removal of the disease—a point of the highest importance when it is situated far back. The constant sponging necessary to prevent blood running into the larynx is calculated to flurry the surgeon, and the result is that he does not cut sufficiently wide of the disease, and the whole object of the operation is defeated. Hence, except when the disease is limited to the tip of the tongue, it is advisable to perform a preliminary laryngotomy. The intratracheal method of administration of anæsthetics described on p. 33 also prevents the entrance of blood into the air-passages.

Remote dangers.—These are mainly *septic risks*, and it is of the highest importance to adopt measures to minimise them. The most serious risk of sepsis occurs in operations about the base of the tongue, and in the cases in which it is deemed advisable to practise an extensive removal of the cervical glands at the same operation as that in which the disease in the tongue is removed ; the latter necessarily opens up the cellular planes and establishes a direct communication with the buccal cavity.

In spite of the fact that the operation is done in a septic cavity, it is

important that the same precautions should be taken to *disinfect instruments, hands, etc.*, as are employed in operations through unbroken skin. Although organisms abound in the mouth, many of them are comparatively harmless, and it is essential to avoid the risk of introducing more virulent ones from without.

Another point of importance is to *diminish the amount of sepsis present in the mouth before operation.* These cancerous ulcers are often excessively foul, and there is much putrid material not only on the surface of the sore but also between the teeth and in the folds of the mouth, and this may soil the cut surface extensively during removal of the tongue. Hence attention should be directed to the hygiene of the mouth for some days before the operation. The patient should cleanse the mouth frequently with mouth-washes, such as boro-glyceride (ʒj to the oz. of water), strong sanitas solution or peroxide of hydrogen (10 to 20 vols.). The teeth should be scaled and stumps removed, and the folds between the gum and the cheek, and the gum and the tongue, should be cleansed with antiseptic lotions. It is on and between the teeth that the septic material mostly accumulates, and this accumulation is facilitated by the fixity of the tongue so often present. It is well to put the patient into the dentist's hands a few days before operation. It has been recommended that the patient should undergo preliminary vaccine treatment against those organisms in his mouth to which his opsonic index is unduly low. Theoretically this is very plausible, but in practice it is of doubtful value, and it will hardly ever be wise to spend the comparatively long time required for the investigation and carrying out of this treatment. It is always important to remove a cancer of the tongue as soon as possible.

We have employed preliminary injections of *anti-streptococcus serum* (see *Practitioner*, April 1897) with the view of diminishing the risk of sepsis. The chief organism concerned in septic troubles after these operations is the streptococcus pyogenes, and it seems worth while to administer this serum beforehand, so as to render the patient less susceptible to the streptococcus rather than to wait until it has gained a footing in the tissues.

At the time of the operation *the ulcer itself should be painted over with undiluted carbolic acid*, or seared with the actual cautery, before any incision is made. Care must be taken to prevent the acid from coming in contact with the healthy mucous membrane, and the tongue should be pulled as far out as possible before it is applied.

The risk of sepsis may also be diminished by planning the operation so that part, if not the whole, of the wound in the mouth may be subsequently closed by stitches. It used to be the custom to leave a large raw surface after removal of half or the whole of the tongue, which necessarily became the seat of septic infection, so that it is not surprising that in many cases the organisms spread into the cellular tissue between the muscular planes and gave rise to serious constitutional disturbance. If

these wounds in the mouth can be closed they heal rapidly, and therefore we always attempt to arrange the incisions so that part of the wound, at any rate, can be stitched up. When only half the tongue is removed this is done by dividing the tissues somewhat obliquely, so as to leave small flaps of mucous membrane above and below, which can afterwards be approximated by catgut stitches. A considerable amount of mucous membrane can often be saved in this way, and we regard it as a point of special importance in cases in which the wound is near the root of the tongue and the tonsillar region, and in which accumulation of putrefying discharges is extremely likely to give rise to septic cellulitis and pneumonia. In the majority of cases it is impossible to stitch up the wound completely, but even partial closure (especially when it can be done towards the back of the throat) not only diminishes the risks of sepsis, but also enables the patient to swallow and to move the tongue much better than he otherwise could. Moreover, if the tip of the tongue can be stitched over, it does not become bound to the floor of the mouth in the same way that it does when a large raw surface is left, nor will there be so much interference with speaking and swallowing.

A useful precaution against sepsis is to *swab out the wound and all its recesses with a solution of chloride of zinc* (gr. 40 to the oz.) at the end of the operation. This closes the routes of absorption to a considerable extent and thus delays the onset and spread of sepsis.

The septic troubles are chiefly cellulitis, acute septicæmia, and septic pneumonia. Acute septicæmia is the most common, and this is the reason why we lay so much stress upon the importance of local precautions. Once septic pneumonia is established there is practically no hope for the patient.

The treatment of the glandular area.—In operations for cancer of the breast it is the accepted practice that the entire glandular area in the axilla, and also the lymphatic tracts between the tumour and the glands, must be cleared away. The question arises whether this should be done in cancer of the tongue. In cancer of the breast there are almost invariably plugs of cancerous cells in the lymphatic vessels running from the breast to the infected glands ; were the latter alone removed, the disease would be very apt to recur in the lymphatic vessels, especially over the pectoral fascia. This infection of the lymphatics apparently does not occur to the same extent in cancer of the tongue, and it is usually only in advanced cases that there is an infection of the tissues between the tongue and the glands, and then it probably arises from direct extension. Hence it is not always necessary to remove the tissues between these two structures, in other words to cause the wound in the mouth to communicate with the triangles of the neck.

Another question of importance is whether the fat and glands should be removed from the anterior triangle, as is done in the axilla, when no glandular enlargement can be felt at the time of the operation on the

mouth. Experience in cases of cancer of the tongue has been much the same as that in cancer of the breast. Recurrence in the glands of the neck occurs almost uniformly when the mass in the tongue has been removed, and the glands left untouched because they were not noticeably infected. On the other hand, the results of those who, like the late Sir Henry Butlin, have made a practice of systematically clearing out the entire glandular area on one or both sides of the neck at, or soon after, the time of the operation upon the tongue, show such an improvement upon the ordinary results, that there can be little doubt that the rule of clearing away the glandular area should hold as strictly in the case of the tongue as it does in that of the breast. When the disease is limited to one side of the tongue, removal of the glands may be restricted to the same side of the neck in the first instance, and a similar operation upon the other side need only be undertaken if enlargement of the glands is noticed there. When, however, the growth obviously encroaches upon the middle line or indeed is suspiciously near it, both sides of the neck should be cleared out without waiting for enlargement of the glands to declare itself.

Should the glands be dealt with at the same time that the disease in the tongue is removed? It is obviously better for the patient's comfort and peace of mind to complete the whole operation at one sitting, and, as a rule, this can be done when the operation upon the tongue is neither a severe one nor likely to cause a wound communicating with that made in the neck for the purpose of removing the glands. The necessity for a second severe operation a few days after the first is very discouraging to the sufferer and may have a bad effect on his nervous system. On the other hand, in many cases it is best for the patient to perform the two operations at different times.

When both operations are to be performed at the same time, the surgeon should begin by removing the glands in the neck: this is an aseptic operation and, when completed, the wound is stitched up and covered with dressing before the disease in the mouth is attacked. When removal of the disease in the tongue does not involve a communication with the dissection in the neck, it is well to tie the lingual artery while the glands are being removed, as the vessel is fully exposed during that operation and the procedure does not demand any extra time, and indeed shortens the operation in the mouth considerably by diminishing bleeding.

The cases in which this question assumes its greatest importance are those of advanced disease, either in the neck or in the tongue. Removal of the glands in bad cases such as would formerly have been deemed inoperable (where the jugular vein is involved and the disease extends up into the parotid region and beneath the sterno-mastoid) is a prolonged operation, and patients with disease so advanced as that are generally weakly and liable to shock. Moreover, should the disease in the mouth be extensive, its proper removal will necessitate a communication between the floor of the mouth and the dissection in the neck, and acute sepsis in

the planes of the neck is very likely to occur. In these cases, therefore, it is well to divide the operation into two stages, allowing a week to elapse between each, and the question then arises as to which operation should be performed first, the removal of the tongue or that of the glands. The answer will depend on the part most affected. In bad cases such as these, the process usually spreads much more rapidly in the glands than in the tongue, and it will generally be found advisable to remove the glands first, and to leave the excision of the tongue to a later period. It is only when the disease in the mouth is extensive and the glandular affection is not marked that the reverse procedure is advisable.

THE OPERATIONS UPON THE TONGUE.

We shall consider first the methods for the removal of the disease in the tongue and afterwards those for the extirpation of the glands from the neck.

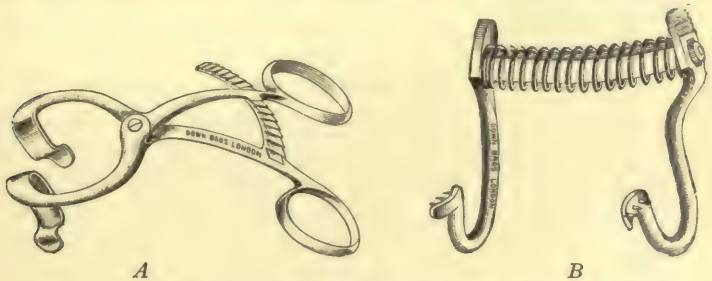
Many operations have been recommended for cancer of the tongue, and different cases require different methods, the particular one employed depending partly on the situation and partly on the extent of the disease. When the growth is limited to the anterior part or the border of the tongue, a much less severe operation will be required than when it is situated in the neighbourhood of the pillar of the fauces, and the same will be the case when there is only superficial disease and the growth has not yet penetrated into the deeper muscles of the tongue, as compared with marked infiltration of the latter. When the disease has not extended into the deeper muscles, it is often sufficient to take away only the affected area along with a suitable amount of healthy tissue around. In this way a great part of the organ can be preserved and its usefulness is not materially interfered with. When the disease is well to one side, the tip of the tongue may be left intact, and this is a matter of much importance for the subsequent power of articulation. On the other hand, when the disease has penetrated into the muscles, one half of the tongue at least must be removed right back to the base, because the majority of the lymphatics run parallel with the muscular fibres, and every movement of the muscle forces on the lymph ; hence a muscle infected by cancer should be looked on as diseased throughout its whole extent and should therefore be removed as freely as possible.

The procedures that may be adopted for the removal of the tongue are (1) cutting out the growth along with a certain amount of the tongue from within the mouth—the intra-buccal methods ; (2) those in which this procedure is only feasible after gaining extra room, for example, by splitting the cheek ; (3) removal of the tongue after dividing the symphysis or some other portion of the lower jaw, and pulling the two halves of the bone asunder ; and (4) removal of the organ through incisions made entirely beneath the jaw—the type of which is that known

as Kocher's operation. The choice between these methods will be influenced largely by the extent and situation of the disease. We shall describe the various operations that are suited for removal of disease in particular situations in the tongue.

(*a*) **When the disease is superficial and is limited to the tip of the tongue.**—In these cases a V-shaped excision of the tip will usually suffice. No preliminary laryngotomy will be required.

V-shaped excision of the tip of the tongue.—The neck should be steadied upon a sandbag, with the head somewhat dependent over it and turned well to one side. A Mason's, Doyen's, or Lane's gag (see Fig. 27) is used, and the assistant is instructed to press down the angle of the mouth on the side towards which the head is turned in order to allow the blood to run out freely. A stout silk thread is inserted through the base of the tongue on each side by passing the finger over the dorsum into the space on either side of the median glosso-epiglottidean fold, pulling up the front part of the organ forcibly and thrusting a nævus needle



A *B*

FIG. 27.—GAGS FOR OPERATIONS UPON THE TONGUE. Both forms are self-retaining, *A* being Doyen's, and *B* Lane's.

armed with stout silk through the under-surface of the tongue as far back as possible, and bringing it out where the finger lies in front of the epiglottis. This suture gets a good purchase and brings the tongue as far forward as it will come, and is a much better way of doing this than by passing the thread through its tip or by pulling it forwards by forceps. The thread is entrusted to an assistant who pulls the tongue forwards and steadies it. The portion of the tongue to be removed is then seized with a pair of tenaculum forceps.

In order to allow the tip of the tongue to come forwards, the frenum is divided with a pair of long-handled blunt-pointed scissors, the division stopping short of the ranine artery; if necessary, the tongue can be brought still further out by dividing the anterior pillars of the fauces. A V-shaped incision is then made with scissors through the mucous membrane (see Fig. 28), at least an inch wide of the growth, and the central portion of the tongue is cut out with a few snips of the scissors, careful watch being kept for the ranine arteries as the incision is deepened; they are easily seized and twisted. The portion of the tongue external

to the incision may be steadied by grasping it with catch-forceps while the central portion is being cut out. After the bleeding has been arrested, the sides of the V are brought together with catgut sutures inserted deeply into the substance of the tongue so as to bring the raw surfaces into apposition everywhere. No dressing is required; the patient should use an antiseptic mouth-wash frequently. He can usually be allowed to get up in two or three days and is well in about a week. The diet should be fluid or semi-fluid, and the food should be introduced into the mouth far back and to one side by means of a rubber tube attached to the spout of a feeder.

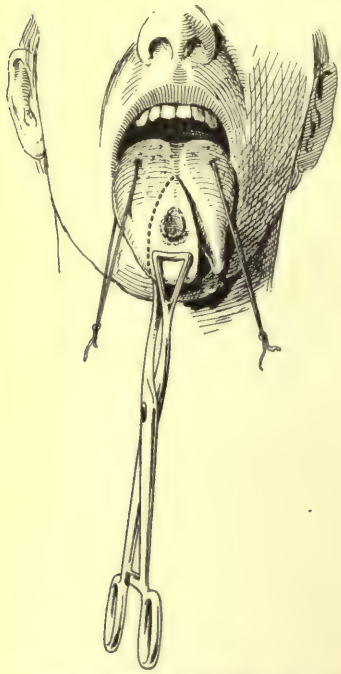


FIG. 28.—V-SHAPED EXCISION OF THE TIP OF THE TONGUE. The chief object of the sketch is to show how the sutures introduced through the base of the organ hold the tongue firmly forwards. As the V-shaped incision is made, the tip of the portion remaining on each side is steadied with catch-forceps. The incision should go at least an inch wide of the growth in all directions.

(*b*) **When the disease is superficial and situated at the side of the tongue.**—Here a partial operation may often be done. The tongue is pulled forwards by the sutures inserted as described above (see p. 85), the frenum and the anterior pillars of the fauces divided, and the tip seized in tongue forceps and pulled well to the opposite side; a portion of the organ in the neighbourhood of the tumour is then excised, the tip of the tongue being left intact. The portion removed may be either quadrilateral, extending well up to the raphe, or wedge-shaped, according to the extent of the disease. In all cases the line of section should be at least an inch wide of the growth in all directions. When a quadrilateral portion is removed, it is well to save as much of the mucous membrane as possible and loosen it in the floor of the mouth, so that it may be stitched to the mucous membrane on the dorsum after the operation is completed. When a wedge-shaped portion has been removed, stitches are inserted so as to approximate the sides of the wedge; although this deflects the tip of the tongue to one side, it has the advantage of rapid closure of the wound; deflection of the tip of the tongue is inevitable under any circumstances, but in spite of this, the functional result is excellent. In many cases it is well to effect the *division of the tongue with the thermo-cautery*, and this has two considerable advantages. In the first place the coagulation caused by the heat fixes the muscles, and so it is

easier to keep to the line of division originally decided upon than when contractile muscles are cut through with a knife or scissors, and in the second place the heat of the cautery destroys any cancer cells that may be near the line of excision. A broad flat cautery at a dull red heat should be used and the parts seared through slowly. Paquelin's cautery is preferable to the galvano-cautery or the galvanic écraseur. The adjacent parts of the jaws and mouth must be protected from the heat. A preliminary laryngotomy is not necessary.

These partial operations can only rarely be employed, but possibly they are not practised as frequently as they might be. Fig. 29, taken from the late Sir Henry Butlin's article on operations on the tongue in

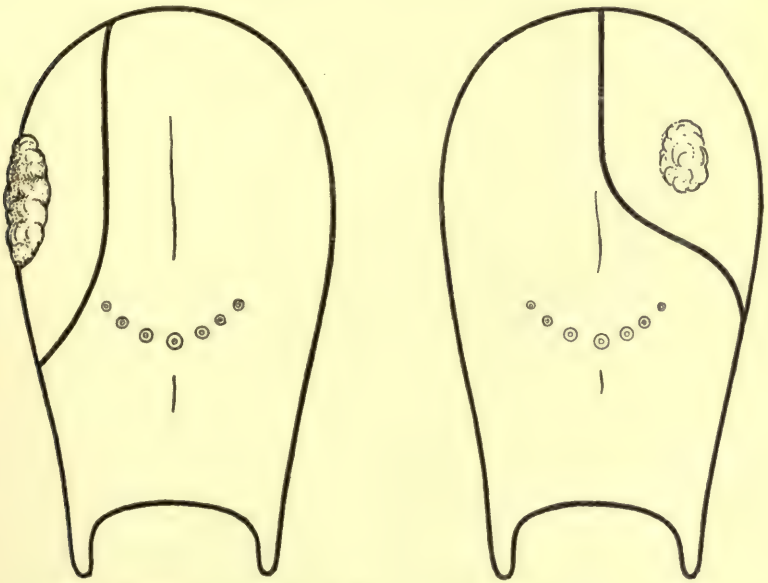


FIG. 29.—INCISIONS FOR REMOVAL OF SMALL GROWTHS FROM THE TONGUE. (*Butlin.*)

the 'System of Operative Surgery,' vol. ii., shows how some of these partial operations can be done.

(*c*) **When the disease is fairly extensive, but is limited to one side of the tongue.**—The great majority of these cases can be dealt with by an intra-buccal operation, provided that there is not much infiltration of the muscles of the tongue. The type of this operation is that formulated by Mr. Walter Whitehead, of Manchester, and commonly called by his name. Various surgeons have modified the steps of the operation, and we shall here describe the one we are accustomed to perform. It differs from Whitehead's original operation (which is described on p. 90) merely in a few details.

Operation.—The patient lies with the shoulders well raised on a

sandbag and the head turned fully over to the sound side. The mouth is widely opened with a self-retaining gag such as Lane's (see Fig. 27, *B*), which does not slip, takes up very little room and is applied far back on the sound side so as to keep the angle of the mouth wide open and thus allow the blood to collect in the hollow of the cheek, and subsequently run out of the mouth. A large retractor at the opposite angle of the mouth pulls the cheek well back so as to expose the buccal cavity thoroughly. A good light is essential and the patient should either face a window or artificial illumination should be used. A preliminary laryngotomy is advisable in the more advanced cases, and then the pharynx should be packed with sponges. The anæsthetic should be chloroform. A silk ligature is passed through the base of the tongue on the sound side in the manner described on p. 85, and the tip of the half that is to be removed is pulled out with tongue-forceps (see Fig. 30), the tip on the other side being seized with catch-forceps. The surgeon takes charge of the tongue-forceps, while the ligature and the catch-forceps are entrusted to an assistant, whose duty it is to pull the tongue well forward and to keep the mouth sponged well out ; he should be provided with plenty of sponges on holders or forceps. The tongue can be pulled out still farther by dividing the frenum and the anterior pillars of the fauces on each side. This is done by clipping each with scissors and enlarging the gap by the fingers.

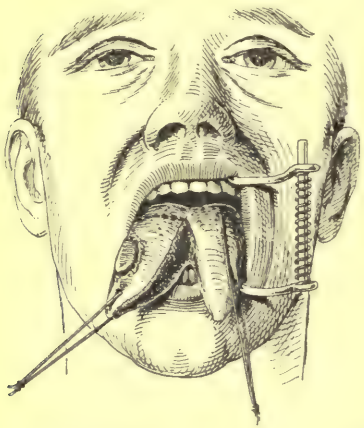


FIG. 30.—REMOVAL OF ONE HALF OF THE TONGUE BY THE INTRA-BUCCAL METHOD. A suture is inserted through the tip of the half to be removed, and another through the base of the opposite half. The tongue is split in the middle line, and the dotted line indicates the transverse incision well behind the growth. A retractor should be used to pull back the angle of the mouth on the right side.

The steps of the operation vary somewhat, according to whether the disease encroaches upon the floor of the mouth or not.

When the disease does not encroach upon the floor of the mouth, the simplest plan is to begin by splitting the tongue along the raphe right back to the base. The mucous membrane should be divided either with a knife or by running one blade of a pair of sharp-pointed scissors beneath the mucous membrane in the middle line along the dorsum towards the base, and dividing the mucous membrane as it goes ; a similar procedure is carried out in the middle line of the under-surface of the tip. The tongue can now be split by seizing one half in each hand and separating the muscular fibres by means of the finger ; this method saves considerable bleeding. The surgeon then divides the mucous membrane and the muscles in the floor of the mouth on the affected side by a series of short

snips with a pair of blunt-pointed straight scissors, beginning at the frenum and proceeding from before backwards. As the division proceeds, the half of the tongue to be removed is pulled upon, so that the growth comes more and more forward and the operation is performed practically outside the mouth. The removal of the affected portion of the organ is completed by making a transverse incision across it well behind the growth. As a rule it is easy to identify the lingual artery and secure it before it is divided, but, should it spout, it can be secured by pulling forward the tongue by means of the suture passed through the base on the sound side. Should there be any difficulty in seizing the bleeding vessel it is well to remember that the hæmorrhage can be temporarily arrested by slipping the forefinger back to the root of the tongue, hooking it well forward and pressing firmly outwards against the angle of the jaw. After the lingual artery has been secured, all that remains to be done is to detach the half of the tongue by a few snips of the scissors.

When the disease encroaches upon the floor of the mouth the operation should be modified. The frenum is freely divided with scissors close to the jaw. The scissors are then introduced beneath the mucous membrane of the floor of the mouth and run along beneath it well wide of the disease —at least an inch if possible— until the anterior pillar of the fauces is reached. The tongue can now be drawn forward freely, so that the operation becomes almost extra-buccal and is finished as described above. In these cases it is necessary to cut deeper into the floor of the mouth, and it is always well to shell out the sublingual salivary gland.

When the disease extends far back at the side of the tongue, it is necessary to get as complete access to the back part of the tongue as possible. As a rule this can be obtained by splitting the cheek from the angle of the mouth back to the masseter ; in some cases, however, it may also be necessary to divide the jaw as in Langenbeck's operation (see p. 95). The method of gaining access by splitting the cheek is especially suitable for cancer in the neighbourhood of the anterior pillar of the fauces. The assistant grasps the whole thickness of the cheek above and below the proposed line of incision and the surgeon then divides it horizontally back from the angle of the mouth to the masseter (see Fig. 33, *AB*). The facial vessels and any other bleeding points are picked up, and the edges of the aperture thus made are retracted, so that a good view of the base of the tongue is obtained when the organ is pulled over to the opposite side. The parts come still further into view if the mucous membrane and the pillars of the fauces have been divided. The deformity is inconspicuous, particularly in men, and union always takes place readily. The incision in the cheek is sutured accurately at the end of the operation, fine horsehair or silkworm-gut being used for the cutaneous, and catgut for the mucous surface.

These operations are accompanied by a variable amount of oozing,

which may persist for some time. There is, however, very little arterial bleeding, and practically all fear of hæmorrhage is over as soon as the lingual artery has been controlled. It is well, therefore, to proceed rapidly with the operation, trusting to the fact that the bleeding will cease when the lingual is secured and the organ removed. It is the assistant's duty to see that no danger arises from the presence of blood in the mouth.

After the portion of the tongue has been removed and the bleeding arrested, the wound is swabbed with chloride of zinc solution (gr. 40 to the oz.), taking care to see that the patient does not swallow any of it; no other application to the raw surface is necessary. Any flaps of mucous membrane that have been saved are brought together by catgut stitches. It is especially important, if possible, to suture the mucous membrane on the dorsum to that on the under-surface of the tip of the tongue, so that the latter remains free and is not bound down in the floor of the mouth. It does not matter much if there is considerable tension on the edges of the flaps of mucous membrane which are brought together in order to diminish the raw surface in the mouth. Adhesions will form even if the stitches cut their way through, and some diminution at any rate will take place in the size of the wound during the early stages of repair, when the risk of sepsis is greatest. Of course, the stitching of the wound in the mouth must be done judiciously. It is possible, for instance, to make the tongue unduly long by suturing the mucous membrane over the raw surface too far back; while, on the other hand, if no suturing is practised, the raw surface beneath the tip and that on the floor of the mouth will adhere, so that the organ is tightly bound down and articulation is much interfered with.

The suture is removed from the sound half of the tongue, and the patient is put back to bed, with the head turned well over to the affected side and the mouth somewhat dependent, so that any blood may escape. As soon as the patient has recovered from the anæsthetic he should be propped up in the sitting position, and is generally able to get out of bed in three or four days. The details of the after-treatment are described on p. 99.

(*d*) **When the disease extends beyond the middle line, but is limited to the tongue,** the entire organ will require removal. This may be done by Whitehead's operation, though we prefer Syme's or Kocher's in these cases. *Whitehead's operation* is described by him as follows (*British Medical Journal*, 1891, vol. i. p. 962):—

A preliminary laryngotomy will obviate all risk of asphyxia, and will be a source of satisfaction to the surgeon, although, as a perusal of the subjoined account will show, it is not essential, especially in the hands of an experienced operator. If this is not done, the administration of the anæsthetic by the intra-tracheal method (see p. 33) is useful.

'The ligature passed through the anterior portion of the tongue is a

great aid throughout the operation, and much depends upon the dexterity of the assistant in anticipating the intentions of the operator, and in always making traction in exactly the right direction, his aim being to make tense those tissues which are immediately to be divided.

'The first step in the actual operation consists in the separation of the tongue from its attachment to the floor of the mouth and the anterior pillars of the fauces, and I would lay stress upon the way in which this is done, because the ease with which the operation is continued depends largely upon the freedom with which this separation is carried out. The two structures principally responsible for the retention of the tongue within the mouth are the frenum and the anterior pillars of the fauces; and, if these are completely divided in the first instance, the tongue may be so freely drawn from the mouth that the operation is practically converted into an extra-oral excision. Extended practice has made me conduct this part of the operation with less deliberation and more rapidity than was my habit in my earlier cases. Instead of the cautious snipping I originally advocated, I now boldly cut until I get close to the vicinity of the main arteries, disregarding all bleeding, unless an artery distinctly spurts, when I twist it and proceed. The more profuse the general oozing the more rapidly I proceed, my object being to get as quickly as possible to the main arteries, as I have confidence that all subsidiary bleeding will cease immediately after their division. There is, in reality, no difficulty in determining the actual position of the lingual arteries, as they are practically invariably found in the same situation, and it requires very little experience to seize them with a pair of forceps before dividing them; if this be done there need not be the slightest hæmorrhage from this source. When once the vessels are effectually twisted, the rest of the tongue may be removed without any further anxiety about hæmorrhage; but it is desirable, before finally severing the last attachments, to pass a loop of silk through the glosso-epiglottidean fold, as a provisional measure of security, in case it may become necessary to make traction on the posterior floor of the mouth, either to assist respiration or to arrest any possible consecutive hæmorrhage. Traction on this ligature of itself arrests hæmorrhage, and makes it an easy matter to secure any bleeding vessel. As the retention of this ligature is a source of some annoyance to the patient, I always remove it at the end of twenty-four hours. As a matter of fact, I cannot recollect its having been required in more than two cases, and but for the certain sense of confidence it gives to those who are left in charge of the patient I should dispense with the precaution altogether were I influenced solely by the amount of benefit I have derived from its use.

'The treatment of the floor of the mouth after the tongue has been removed is a matter of considerable moment. The first object is to make the cut tissues as far as possible aseptic, and for this purpose I am still in the habit of swabbing the parts with a mercurial solution, and, after

drying, finally painting the surface with the iodoform styptic varnish which I introduced in 1881. This preparation, in addition to its antiseptic properties, has the advantage of lessening the discomfort which follows when the surface is left unprotected, and it also enables the patient to take food in the ordinary manner almost immediately after the operation.

'The mercurial solution I prefer is that of the biniodide, and the strength I am in the habit of using is $\frac{1}{1000}$. I have recently made, and I think with advantage, a slight addition to the iodoform varnish. My original custom was simply to substitute for the spirit ordinarily used in the preparation of friar's balsam a saturated ethereal solution of iodoform, but now I prefer to mix with the ether one volume in ten of turpentine. This addition has a very marked influence in promptly checking the capillary oozing which occasionally prevents a dry surface being quickly secured.

'I was at one time in favour of suspending all alimentation by the mouth for the first four days, and feeding the patient entirely by nutrient enemata; but for some years I have entirely abandoned this practice, and I now feed the patient with liquids, by the mouth, as freely and as early as possible, only using enemata when it is necessary to supplement the amount of food the patient is otherwise able to take; and I find that if a coat of the varnish is applied daily, patients rarely have any difficulty in taking an adequate amount of sustenance. It fortunately happens that the patients appreciate rather than object to the application of the varnish, and they will often ask for its use more frequently than once a day.'

The ligature at the base of the tongue should either be fastened to the teeth or kept hanging out of the mouth by the weight of a pair of forceps.

Kocher's Operation.—This is a well-known operation and was at one time widely used. We generally, however, prefer operations such as Langenbeck's or Syme's (see p. 96), in which the jaw is divided, as they give a much better view of the parts than is obtained in Kocher's operation.

In a typical Kocher's operation a *preliminary tracheotomy* is necessary, so as to enable the pharynx to be plugged with sponges. This prevents blood passing into the air passages and also does away with the risk of the epiglottis falling back over the larynx after the entire tongue has been removed; when the base of the tongue is removed, the orifice of the larynx will almost certainly become blocked and the patient will become asphyxiated unless a preliminary tracheotomy has been done. A laryngotomy opening is too near the area of operation, and blood might get down the tube; intra-tracheal administration of the anæsthetic (see p. 33) may, however, replace the tracheotomy.

After the tracheotomy tube has been inserted—which should preferably be a Hahn's or Trendelenburg's cannula (see Fig. 31)—the shoulders are raised on sandbags and the head is allowed to hang some-

what downwards, and is turned towards the side upon which the disease is least extensive. The incision (see Fig. 32) commences at the symphysis, and sweeps downwards and somewhat backwards to the hyoid bone. It is carried along parallel to the latter structure, and backwards nearly to the anterior margin of the sterno-mastoid muscle, and then sweeps upwards and backwards over the anterior border of this muscle towards the lobe of the ear. In Kocher's operation, as usually described and figured, this incision is angular, but it is best to make the large curve here described. The flap of skin and superficial fascia thus marked out is turned up over the jaw, the deep fascia over the anterior triangle and the submaxillary region divided and the glands removed, the submaxillary triangle being entirely cleared out. Should it be decided to clear out the glandular area from the anterior triangle at this operation, it will be

A *B*

FIG. 31.—HAHN'S AND TRENDELENBURG'S CANNULÆ. *A* is Hahn's tube, which is packed round with sponge. *B* is Trendelenburg's, in which the blocking of the trachea around the tube is done by an inflation apparatus.

necessary to continue the incision along the border of the sterno-mastoid well down below the level of the cricoid cartilage.

The mylo-hyoid muscle is now divided, leaving nothing between the wound in the neck and the mouth but the mucous membrane. The latter structure is next divided from before backwards on the side of the operator and the anterior pillar of the fauces is clipped across; to do this it is necessary to open the mouth with a gag. The tongue can then be drawn out through the wound in the neck.

The later steps of the operation depend upon whether the whole or only one half of the organ is to be removed; in the latter case it is well to split the tongue in the middle line along the raphe from inside the mouth (see p. 88). When the entire organ is to be removed, the mucous membrane and the anterior pillar of the fauces on the other side should be divided from inside the mouth, the mouth shut and the lower jaw forcibly pulled up with a stout retractor, whilst the tongue is pulled out through the wound in the neck. This exposes the whole lateral area and base of

the tongue, and the affected portion is easily clipped away with scissors, or, still better, divided with the thermo-cautery, well wide of the disease. The arteries are seized and tied as they are divided.

There is no doubt that this is a good method for complete extirpation of the tongue. When the disease infiltrates the muscles down to the hyoid bone, it is easy to leave some portion of it behind in less extensive operations, whereas in Kocher's the whole muscular mass is exposed and the excision can be carried as far back and as low down as may be necessary. But at the same time, it is only essential for those cases in which the infiltration extends far back or deep down, and in which the whole of the organ has to be removed right back to the hyoid bone. Kocher himself speaks of it as an operation that could be carried out antiseptically. This, of course, is not possible. At the same time, however, the sepsis is more or less superficial and possibly may be kept under control by packing the wound in the mouth with antiseptic gauze; this can be continued as long as a tracheotomy tube is retained.

FIG. 32.—KOCHER'S INCISION FOR REMOVAL OF THE TONGUE. The dotted line shows the direction in which the anterior triangle may be opened up if necessary.

Dressings.—After the tongue has been removed, and the bleeding arrested, the surface of the stump is sponged with a solution of chloride of zinc (gr. 40 to the oz.) and the mouth is firmly packed with cyanide or iodoform gauze. Caution must be observed in using the latter because several cases of iodoform poisoning have occurred. The external wound is stitched up and one or more drainage tubes are inserted, passing from the most dependent parts of the mouth wound into the neck, so as to carry off all discharge freely. The Hahn's tube is removed, and either a fresh one is inserted for twenty-four hours or an ordinary tracheotomy cannula is substituted, according to the likelihood or not of discharges finding their way through the glottis.

(*e*) **When the disease extends from the base of the tongue to the surrounding structures.**—Cancer of the base of the tongue, with extension to the floor of the mouth so that the tongue cannot be protruded owing to infiltration of the muscles, cannot be treated efficiently by intra-buccal operations. It is most essential to obtain

free exposure of the disease. Hesitation to adopt any means to this end on account of deformity which would ensue is unjustifiable. It is not a question of merely removing the visible cancer from the mouth. It is important to get well beyond it, so as to avoid the chance of local recurrence, and this can only be done by obtaining a thorough exposure of the parts to be operated upon.

Splitting the cheek (see p. 89) will often enable good exposure to be obtained, but for proper access when the surrounding structures are infiltrated it is almost always necessary to divide the jaw.

Division of the jaw.—When the base of the tongue is widely infiltrated, and particularly when the floor of the mouth and the tonsillar region are encroached upon, assistance may be obtained by dividing the jaw and splitting the cheek, as recommended by Langenbeck (see Fig. 33). In *Langenbeck's operation* the whole thickness of the cheek is divided horizontally backwards, and when the anterior margin of the masseter is reached, the incision is curved downwards across the jaw into the neck and then turns forwards over the hyoid bone, and finally upwards towards the symphysis; in this way a flap is raised and any glands in the submaxillary region may be dissected out. The jaw is divided opposite the last molar tooth, and the posterior portion is pulled firmly outwards, whilst the anterior part is pulled forwards; this facilitates access to the floor of the mouth and base of the tongue (see Fig. 34), and the entire tongue can be removed right back to the base if necessary. In any case the hyoglossus muscles should be divided at their attachment to the hyoid bone and removed entirely. The jaw may be brought together afterwards by silver wires of medium thickness. The holes for the wires should be drilled before the bone is divided if the growth does not affect the jaw, but when there is any doubt about that, it is well not to do this, as the drill-holes may become infected with cancer cells,

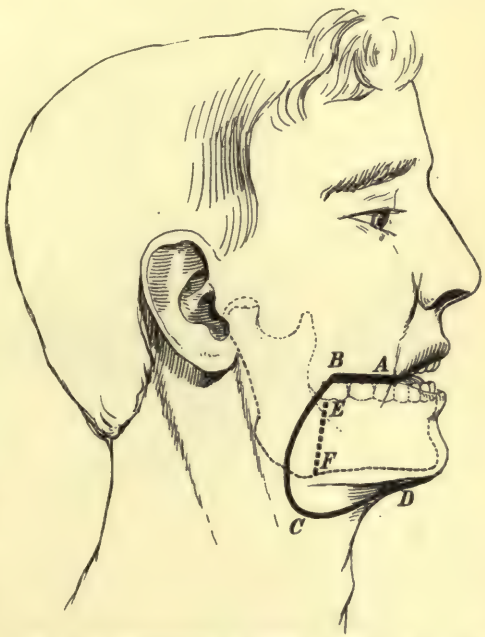


FIG. 33.—LANGENBECK'S DIVISION OF THE JAW. The thick line, *AB*, represents the splitting of the cheek; the curved one, *BCD*, the flap from the face and chin; while the dotted one, *EF*, shows the line of division of the jaw.

and it is not much more troublesome to drill them at the end of the operation.

If the disease encroaches upon the lower jaw itself, it will be necessary to remove a portion of the bone. It is very important not to remove the entire depth of the bone (see p. 45), if it can possibly be avoided, and, while it is still more undesirable merely to peel off the periosteum and remove it in these cases, every legitimate attempt should be made to save some portion of the thickness of the jaw so as to retain the proper form of the bone.

Another condition in which division of the jaw is essential for satisfactory access to the growth is when the latter has spread on to the floor of the mouth in the neighbourhood of the frenum. In these cases there is no possibility of getting sufficiently free access to the back of the symphysis without division of the jaw. For this purpose the operation introduced by Syme is very useful.

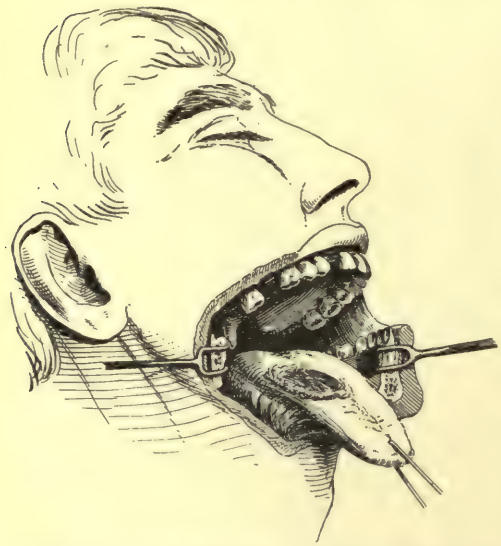


FIG. 34.—LANGENBECK'S METHOD OF EXCISING THE TONGUE. The divided ends of the jaw are pulled forcibly apart and good access is obtained to the side of the tongue and floor of the mouth. The incision is the same as that shown in the preceding figure.

Syme's operation is performed as follows: The lower lip is split vertically in the middle line and the incision in the skin is carried down to the hyoid bone. It will often be found advisable to continue the incisions outwards on each side from this point so as to expose the sides of the tongue more freely (see Fig. 35). A central incisor tooth is extracted and the jaw sawn through its socket; the soft parts are separated from the bone and the two halves of the jaw pulled forcibly apart so as to expose the whole of the anterior portion of the floor of the mouth and the tongue, taking care, however, not to tear the growth. The rest of the operation is carried out with scissors, the mucous membrane being divided well free of the growth on either side and close to the jaw, and the tongue muscles snipped through close to the hyoid bone. A thread should be passed through the base of the tongue so as to keep it forward after the disease has been removed. The whole of the affected area of the tongue, including the contents of the submaxillary triangle, is then removed.

After the bleeding has been arrested, the raw surface should be diminished as much as possible by catgut sutures, the two halves of the jaw wired together, and the thread through the stump of the tongue fastened either to the teeth or to the wire uniting the jaw. This step is essential, as the muscles running from the tongue to the hyoid bone have been divided and the stump will otherwise fall back and may cause asphyxia. This stitch is usually required for three or four days; when there is much tension on the thread it may cut its way through the stump too early. When there is doubt as to its holding, it is well to keep in the laryngotomy tube so as to avoid the risk of asphyxia. This

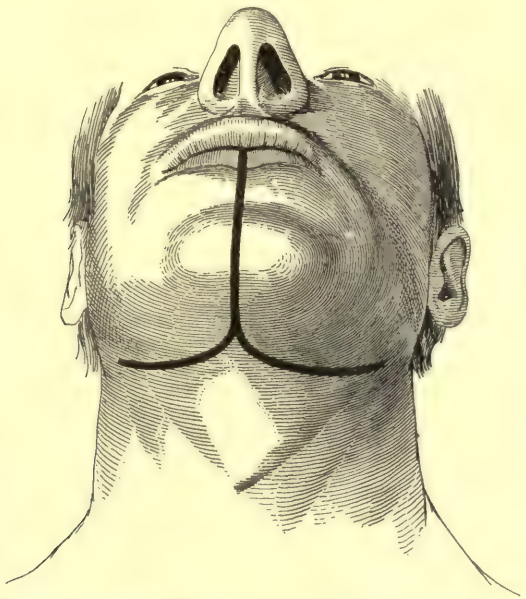


FIG. 35.—SYME'S EXCISION OF THE TONGUE. The sketch shows the method of curving the incision away on each side as it nears the hyoid bone, so as to raise flaps and remove glands. Syme used a simple median incision.

is especially necessary in cases that are not in hospital; in any case the nurse should be constantly at the bedside and should have suitable forceps at hand with which the stump can be seized and pulled forwards if necessary.

When the disease actually implicates the jaw itself, a portion of the bone must be removed. It should be sawn through on either side of the disease, but left attached to and removed in one piece with the growth in the tongue. For the subsequent procedure in consequence of the removal of a portion of the jaw see p. 98.

(*f*) **When the disease has spread over the floor of the mouth and involves the jaw**, the whole of the infected portion

of bone must be removed. No risk of recurrence should be run by being too sparing in the removal of the bone. The remarks made on p. 45, with reference to the pitiable plight of patients who have had portions of the lower jaw excised, apply to the cases now under consideration, and the surgeon must always place the full facts of the case before the patient as dispassionately as possible before operation is decided upon.

Partial excision of the jaw.—When the disease is situated towards the front of the tongue, spreads over the floor of the mouth and infiltrates the muco-periosteum and the ramus of the jaw, the best plan, after performing a preliminary tracheotomy, is to make a curved incision with its convexity downwards, commencing close to the symphysis, running down nearly to the hyoid bone and curving upwards to the neighbourhood of the angle of the jaw (see Fig. 36). This flap is then turned up with all the soft tissues on the outer surface of the jaw, the bone is cleared, the mucous membrane over the jaw is divided in front and behind, well clear of the disease, the necessary teeth are extracted and the jaw is sawn through in front and behind well beyond the limits of the disease. The divided portion of the jaw is now left attached to the tongue, while the glands in the submaxillary region, which are generally infected, are dissected out and the lingual artery tied as it passes beneath the hyoglossus muscle. The mouth is then opened with a gag and the next stage of the operation carried out from the mouth. The mucous membrane of the floor of the mouth is divided in front of the disease, the anterior pillar of the fauces is snipped through and the tongue split along the raphe. The flap is then turned up, the mylo-hyoid muscle divided, and a view of the interior is obtained by pushing the detached portion of bone out of the

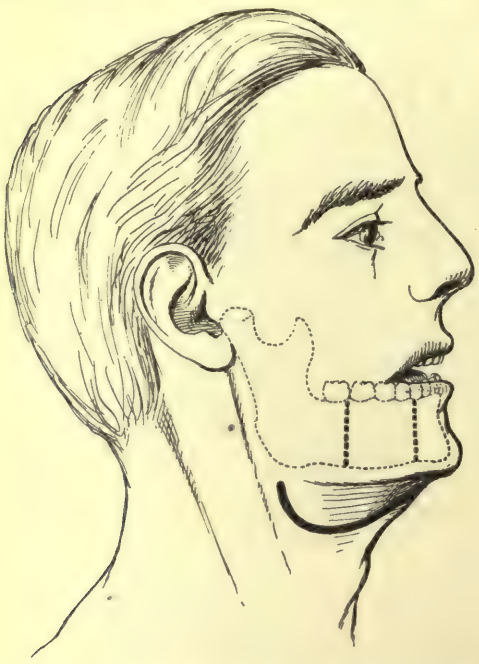


FIG. 36.—INCISIONS FOR REMOVAL OF THE TONGUE AND A PORTION OF THE JAW. The continuous line indicates the skin incision, the dotted ones the section of the jaw.

way. The disease can then be removed, the sublingual gland being taken away along with the affected half of the tongue and the floor of the mouth.

The wound in the mouth is sponged over with chloride of zinc solution (40 gr. to the ounce) and is lightly packed with iodoformed gauze which emerges through an aperture left in the incision in the neck. The treatment of the defect in the jaw must follow the lines already laid down (see p. 48).

After-treatment of operations upon the tongue.—There is considerable diversity of opinion as to the best method of treating the wound after the operation. Dusting the raw surface with iodoform is a dangerous procedure, because a large quantity of iodoform is required, and absorption of the drug from the mouth is free; a number of cases of severe iodoform poisoning have undoubtedly occurred. We have tried Whitehead's varnish (see p. 92), but have not seen any particular advantage from it. Kocher packs the mouth full of gauze and allows the patient to breathe through a tracheotomy tube; we cannot say that we have seen any real benefit from this plan. We prefer to interfere with the wound as little as possible. Antiseptic mouth-washes are used as soon as the patient can employ them, but before that time we simply allow the discharges to be expectorated or to drain from the mouth, facilitating their removal by occasional gentle spraying or syringing of the raw surface with lotions of chlorate of potash or bicarbonate of soda. The nurse is instructed to cleanse the teeth thoroughly and to swab them well with a mouth-wash of boro-glyceride, peroxide of hydrogen or sanitas. When there is a drainage tube leading from the mouth through an opening in the neck, syringing the mouth can be done freely from an early period, as the fluid finds its way out through the tube. The latter should be so arranged that its end projects into the mouth for at least three or four days; it may then be shortened so as to allow the opening in the mouth to close.

If a preliminary laryngotomy has been performed, the tube should be left in for a few hours and then removed. If it is taken out immediately after the operation, as is sometimes done, there is considerable risk of extensive emphysema.

The *feeding* is of great importance. It is well to trust entirely to rectal feeding for two or three days after the more severe forms of operation, unless the patient is very debilitated. This is done not because the patient is unable to swallow, but because the food collects in the wound in spite of the greatest care, and such substances as milk and beef tea decompose rapidly. The patient will do perfectly well for three or four days with rectal enemata (see p. 257) every four hours, the bowel being washed out daily with a large warm-water enema. Should the patient's condition demand it, feeding by the mouth must be had

recourse to in addition to the use of rectal alimentation, or a tube may be passed into the stomach and left there.

Mouth-feeding may be had recourse to from the first in those cases in which the wound in the mouth is small, or the patient is unable or unwilling to be fed *per rectum*, and in these cases it should be done by means of a long soft rubber catheter—No. 14 to 16—attached to a feeder and slipped down the sound side of the pharynx into the œsophagus ; the fluid is poured slowly along it, so as to allow the patient time to swallow. After the food has been administered in this way, the meal may be finished by pouring half an ounce of water down the tube, so as to clear out the last few drops of food, and thus avoid fouling the wound as the tube is withdrawn. The mouth should be thoroughly rinsed out or sprayed with an antiseptic solution immediately after the meal. The patient may be allowed a little ice to suck if he complains of thirst or the mouth feels dry.

At the end of the first twenty-four hours a saline purge should be administered through the tube. All these patients swallow a certain amount of blood either at the time of the operation or afterwards, and this is apt to disorder the digestion ; a purge gets rid of it and the patient is made comfortable. Salol in 10-grain doses three times a day for the first three or four days is also of use.

As soon as the patient recovers from the effect of the anæsthetic he should be propped up in the sitting position, with the head bent well forwards in order to facilitate the escape of discharges from the mouth. It will generally be found that by the second day the patient is able to sit up, and unless the operation has been very extensive, he can usually get up on the fourth or fifth day, and should always be encouraged to do so as soon as he feels inclined. Recovery is usually very rapid when no unfavourable complication arises, so that by the end of a fortnight or three weeks the patient is practically well. He should, however, be kept under close observation for three weeks from the time of the operation, because secondary hæmorrhage may occur at any time up to then ; it is most common from the tenth to the sixteenth day after the operation, and occurs especially when the lingual trunk has been tied in a wound communicating with the mouth.

The question of recurrence.—Should recurrence take place in the mouth, the question of the feasibility of further operation will depend upon where it is situated and on its extent. Frequently it is only a small mass at one end of the cicatrix and is then best removed by simply cutting out the affected area with the thermo-cautery. On the other hand, it may occur in the depth of the wound amongst the remains of the muscles of the tongue and may be inoperable. No special rules can be laid down, but the case must be carefully watched, the patient being seen every three or four weeks for several months, so as to detect a recurrence at the earliest possible period. The thermo-cautery is a

very effectual method of removing recurrence in the superficial parts, partly because it diminishes the bleeding, whereas the cicatricial tissue, which is extremely vascular in the early stages, oozes freely when removed with the knife or scissors, and partly because, as the cautery burns its way through the diseased area, the tissues around are charred, so that much more is destroyed than would be removed by the knife ; moreover the seared surface does not become the seat of septic infection as rapidly as a raw one would.

THE OPERATIONS UPON THE GLANDS.

Glands enlarged secondarily to cancer of the tongue occur early and in various situations, according to the seat of the primary lesion ; the chief situations are the submental and the submaxillary regions, the anterior triangle, or above the digastric muscle. Wherever they may appear first, they soon spread along the carotid sheath and extend backwards under the sterno-mastoid muscle, particularly in the neighbourhood of the mastoid process. We have already pointed out (see p. 75) that it is necessary not only to remove the glands actually enlarged, but also to take away all the glands in and beyond the infected area.

Apart from the removal of cancer of the tongue and mouth, it is now the general practice to operate for the removal of all the fat and glands from the areas which will probably become infected, even though no enlarged glands are actually present ; this is usually done about a fortnight after the operation on the tongue. The areas to be dealt with are the same in both cases, and the description of the operations given below, though referring especially to cases in which glandular infection is already manifest, is equally applicable to cases in which there is no enlargement of the glands. Even greater care must be taken in clearing out these regions thoroughly than when the glands are enlarged, because the loose fat and glands are not so coherent, and small lobules of what is apparently only fat may readily be detached and left behind and may nevertheless contain infected lymphatic tissue. When no enlarged glands are present the operation need not be so extensive as that described below ; for example, it will not be necessary to continue the dissection of the anterior triangle down to the sterno-clavicular joint, nor to remove the internal jugular vein ; but on the other hand the greatest care must be taken to clear the upper part of the triangle, the region of the digastric muscle, the parotid gland, and the tissue above and behind the spinal accessory nerve, and also the submaxillary triangle. It must be borne in mind that if infected material is left behind, a subsequent operation is very difficult and unsatisfactory, on account of the cicatricial tissue resulting from the first.

Clearance of the submaxillary region and the anterior triangle.—In the great majority of cases both the submaxillary

region and the anterior triangle must be cleared out. For this purpose the incision through the skin should be free, and no attempt should be made to avoid scarring the neck. The incision should commence about the level of the lobule of the ear and run along the anterior border of the sterno-mastoid muscle to the lower part of the neck. When enlarged glands are present it may be carried down to the sterno-clavicular joint; when there are none it need not go quite so far. Another incision

FIG. 37.—INCISIONS FOR CLEARANCE OF THE GLANDULAR AREA OF THE SIDE OF THE NECK. The diagram shows the long straight incision (4) along the anterior border of the sterno-mastoid, and (1) the second incision—which is really a little curved in practice—running from it to the symphysis. When there is any considerable enlargement of the glands a third incision is made opposite the figure 3 but running backwards across the sterno-mastoid, which is subsequently divided. 2 is the lower border and 3 the angle of the lower jaw.—(*Butlin*, 'Diseases of the Tongue.')

must be carried forwards from the anterior part of the vertical incision so as to expose the submaxillary region. This begins about the level of the upper border of the thyroid cartilage and runs forwards and somewhat upwards along the hyoid bone, curving upwards to reach the lower jaw (see Fig. 37). From the upper part of this incision and a little below the level of the tip of the mastoid process, another incision should be carried backwards to beyond the posterior border of the sterno-mastoid muscle. This is especially necessary when the glands are enlarged, because it is advisable to divide the sterno-mastoid muscle transversely above the point at which the spinal accessory nerve enters

it, so as to clear out the glands which lie beneath the muscle in the region of the mastoid process and above the nerve.

These incisions are carried through the skin, fat and platysma, and the various flaps are dissected up and turned aside ; the deep fascia need not be divided at this stage, except over the sterno-mastoid muscle and the lower border of the jaw. In turning aside these flaps the external jugular vein will be divided and the two ends should be tied at once ; there are superficial glands around the upper part of the vein which must be taken away. When turning up the flap over the facial vessels glands will also be met with and must be removed.

The whole area thus exposed must be carefully cleared of fat and glands, leaving only muscles, nerves and blood-vessels. The fat and glands should be taken away in one mass, so as to ensure the removal not only of all the glands but also of the lymphatic vessels connecting them. It is well to begin with the submaxillary region and turn the contents backwards, leaving them, however, connected with those of the anterior triangle.

In the submaxillary region the glands are in close connection with the submaxillary gland and also beneath the jaw running outwards towards the angle, and one or two may be met with in intimate connection with the facial vessels. Although the submaxillary salivary gland itself is not affected except by direct extension, it is always advisable to remove it because some lymphatic glands are very intimately adherent to its sheath, and, unless it is taken away, glands may be left behind or torn in the attempt to remove them. Another reason for removing the salivary gland is that the orifice of its duct is likely to be interfered with by the operation in the mouth, and its orifice may be much narrowed, so that a painful swelling and sometimes suppuration may occur in the gland if it is left behind. This may not only be a serious source of annoyance to the patient, but may also be mistaken for recurrence of the growth.

The facial vessels are tied, the glands beside them are removed, and the deep cervical fascia passing from the salivary gland is divided just above the hyoid bone. The finger is insinuated between the lower jaw and the upper edge of the submaxillary gland, and this structure, together with the fat and glands connected with it, is pulled down, taking care not to perforate the buccal mucous membrane. Any glands running backwards from the submaxillary region to the angle of the jaw are also detached from above, and the whole mass is peeled downwards and backwards. The facial vessels are secured before they reach the salivary gland, and the anterior portion of that gland as it passes beneath the mylo-hyoid muscle is shelled out along with its duct. The latter should be ligatured before division and cut short. The whole of the glandular area is thus detached in one mass and turned backwards. Should the operation upon the glands be done as a preliminary to treatment of the

disease in the mouth, the surgeon may ligature the lingual artery in its continuity if he chooses, as it can easily be exposed in the dissection. If there is any reason to suppose that the glands in the submental region are also infected the incision may be prolonged forwards and this area cleared out also (see below).

The *anterior triangle* is the situation in which the enlarged glands are chiefly found, and the one in which the greatest thoroughness is essential, for it must always be remembered that, if the glands are imperfectly removed and recurrence takes place, it is practically impossible to perform a second operation satisfactorily. The first operation therefore cannot be too thorough.

The glands in the anterior triangle are in intimate relation with the sheath of the jugular vein, and from quite an early period it is difficult to separate the two structures without running the risk of puncturing or tearing the glands. At a later period the vein is usually so mixed up with the mass of glands that it is excessively difficult to remove the latter without injuring the vein. The main enlargement occurs near the bifurcation of the carotid artery, but the glands run upwards to the parotid gland, and when the disease is situated at the back of the tongue special care is necessary to remove the glands and lymphatic vessels which cross in front of, and behind, the digastric muscle. In this region also the glands extend outwards under the sterno-mastoid, and are usually divided into two main groups by the spinal accessory nerve. The upper and posterior mass bulges beneath the muscle and is intimately connected with the deep fascia over the deeper muscles in the neck where it extends on to the atlas, and this fascia must be divided above in order to allow of thorough removal.

We have already laid considerable stress (see p. 75) upon the great importance of taking care not to rupture the glands in removing them, lest epitheliomatous infiltration of the wound should occur, and therefore all incisions should be very free, and the entire glandular area should be thoroughly exposed before the removal of the glands is proceeded with. There should be no attempt to pull enlarged glands out of deep recesses when an increase in the length of the incision or a further dissection will enable them to be removed without risk, and no attempt should be made to shell out each individual gland; the whole of the tissues in which the glands are lying must be removed *en masse*. Attempts to shell out soft glands will generally lead to their rupture; should such an accident happen, the best procedure is probably to wash out the wound with a 1 in 2000 sublimate solution and then to open up the whole surface and rub it over with undiluted carbolic acid. We have had accidents of this kind, and in one or two cases no infection followed after using this method; but in others it has failed us, probably because the carbolic acid did not reach some portion of the raw surface.

Certain guides are necessary to perform the operation systematically.

The first guide is the anterior border of the sterno-mastoid, which must be exposed throughout the whole length of the wound. The second is the jugular vein, which should always be exposed below the glandular mass. The third is the spinal accessory nerve.

After the anterior border of the sterno-mastoid muscle has been defined, which is done in turning aside the flaps, the internal jugular vein should be exposed about the level of the cricoid cartilage, and the deep fascia divided along the anterior border of the sterno-mastoid muscle, taking care not to injure any enlarged glands which may be present. To

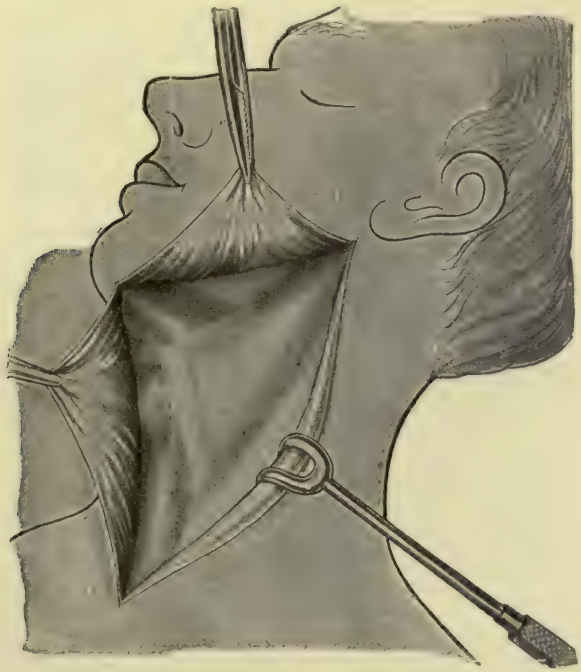


FIG. 38.—EXPOSURE OF THE LATERAL GLANDULAR AREA OF THE NECK. The flaps of skin and superficial tissues marked out in the previous figure have been dissected up, exposing the deep cervical fascia.—(*Butlin*, 'Diseases of the Tongue.')

expose the vein a vertical incision is made through the deep fascia just in front of the anterior margin of the sterno-mastoid muscle at the lower end of the wound, and the internal jugular vein can be exposed almost immediately with the handle of the knife or a dissector.

If the glands are not markedly enlarged the sheath of the vessels should be taken away with the fat and glands, but the vein itself may be left behind. If, however, there is marked glandular enlargement it is, in our opinion, advisable to remove the vein in almost all cases, because its sheath is always more or less adherent, and, moreover, the vein itself is frequently inextricably involved in the glandular mass, and efforts

to dissect off the glands may lead not only to rupture of the glands but also to a wound in the vein and bleeding, which may seriously interfere with the success of the operation. When the vein has been exposed below the glandular mass it is isolated, clamped in two places, and divided between the clamps. The lower end may then be ligatured, whilst the upper portion is pulled upwards and outwards, and the finger is gently insinuated between it and the artery and the vagus nerve, separating it

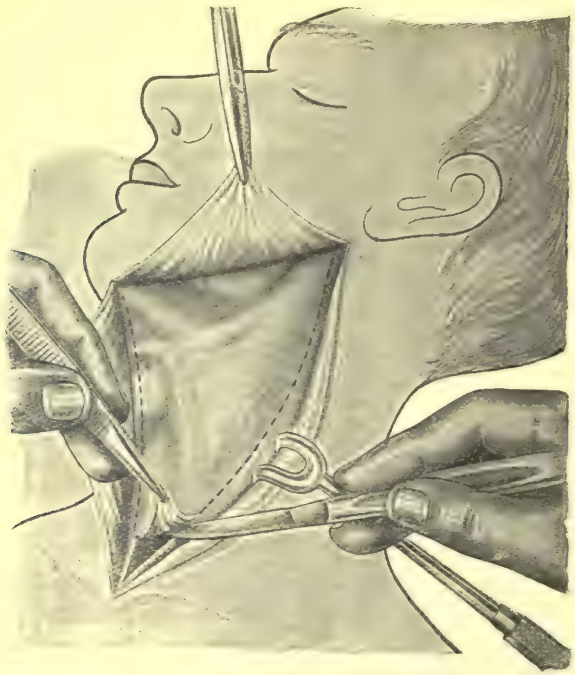


FIG. 39.—CLEARANCE OF THE LATERAL GLANDULAR AREA OF THE NECK. The deep fascia is being dissected up below in order to expose the internal jugular vein. The fascia is divided along the dotted line along the anterior margin of the sterno-mastoid. The second dotted line shows the line of division along the depressors of the hyoid. The operation may be begun from below as shown above, or from above, when the fascia is detached from the ramus of the jaw and the submaxillary triangle cleared out first. —(*Butlin*, 'Diseases of the Tongue.')

gradually upwards together with the whole mass of glands, fat and fascia. This separation is continued until the mass is free of the artery and the nerve, and it is carried as far forwards as the base of the submaxillary triangle and as far upwards as the parotid gland. The mass, with the finger in position behind it, is then lifted up and pushed well backwards, and the deep cervical fascia is divided with a knife from the base of the submaxillary triangle downwards along the outer edge of the depressors of the hyoid bone. This part of the operation will be accompanied by fairly free hæmorrhage and several vessels may be

divided, such as the thyroid, lingual and facial veins; these should be clamped as they are cut. The mass is now free below and in front and can be turned backwards. The digastric muscle will now be seen, and the relation of this structure to the affected area is noted. When the disease in the tongue is far back, the glandular enlargement often involves the muscle, or at any rate will occur both above and below it, and special care must be taken to remove all the fat and glands from its vicinity. Should the glands be adherent to the muscle, there need be no hesitation in removing the latter. The jugular vein can now be secured above the glandular mass by turning the latter backwards and insinuating an aneurysm needle around the vein so as to ligature its upper end. It is then divided below the ligature, and the isolated portion of the vein is taken away with the glandular mass.

The next point demanding attention is the spinal accessory nerve. The glandular mass is replaced in position, pulled well forwards, and the knife is carried through the deep fascia just along the edge of the sterno-mastoid and the parts are detached from the muscle with a dissector until the nerve comes into view. We have never found any difficulty in ascertaining its position, as the handle of the knife or the dissector in stripping off the fascia from the under-surface of the sterno-mastoid generally causes sufficient irritation of the nerve when it touches it to lead to contraction of the muscle. The nerve usually runs right through the mass of glands, but we have rarely found it actually infiltrated. It generally runs in a channel between the glands, and may be isolated by slipping a probe along this channel. Great care is necessary in getting down to and opening this canal to avoid cutting through cancerous glands, and the surgeon should work well from the outer side. The most difficult part of the operation is to clear the fat and glands above the nerve, especially when there is much enlargement in this situation. Fortunately there are few important structures in this region and free removal is unaccompanied by danger. The best plan is to divide the muscle in a line corresponding with the posterior incision in the skin and above the point at which the spinal accessory nerve enters it, leaving enough of the muscle above to enable the ends to be stitched together afterwards. As the division of the muscle proceeds, the incision must be very cautiously deepened because glands are very often adherent to its under-surface. Should this be the case, portions of the muscle must be left in connection with the glands so as to avoid injuring them. The ends of the muscle are thrown upwards and downwards, and a good view of the area beneath is obtained, so that all that is necessary is to divide the fascia behind and above the affected area. Behind, the incision is deepened until the splenius is exposed; the fascia attached to the atlas is then divided and the glands and soft tissues peeled off the deeper parts and pushed down in one mass. The lower part of the parotid gland is now exposed in the wound, and must be examined carefully as enlarged glands are often

present in it. If enlarged glands are present, they should be removed and a slice of the parotid gland taken with them. All the fat, fascia and glands below the spinal accessory are next removed right back into the posterior triangle. The glands are usually not markedly enlarged in this situation and are readily peeled down with a blunt dissector or the finger; only an occasional touch of the knife or the scissors is required.

When the glandular area has been removed, all the structures in the anterior triangle of the neck should be visible, and the carotid artery and the vagus nerve should be pulled aside to see whether there are enlarged glands behind them. The various structures in the submaxillary region are also seen. The under-surface of the sterno-mastoid should be stripped bare of its fascia, and the deeper muscles of the neck should also be seen devoid of their fascial covering. The divided sterno-mastoid is then united with catgut in the ordinary manner (see Vol. II. p. 62).

Clearance of the submental and submaxillary regions.—As a rule it is not necessary to interfere with the submental area unless enlarged glands are present in the submaxillary triangle or unless the growth is situated near the tip of the tongue or on or below the frenum. When this is the case, however, the submental or both submaxillary regions should be cleared. If there is any reason to fear infection of the anterior triangle, the incision should be carried out to the sterno-mastoid muscle and another incision made parallel to the anterior edge of that muscle, as already described.

These areas are most conveniently cleared by an incision parallel to and a little below the lower border of the jaw, running from angle to angle and curving downwards at its extremities. The flap is turned downwards and exposes the whole area. The submaxillary regions are cleared in the manner described above. The glands in the submental region are partly superficial to, and partly beneath and between, the genio-hyoid muscles. After the superficial fat and fascia have been removed the latter muscles should be separated and the fat and glands beneath them taken away.

After-treatment.—When the wound does not communicate with the mouth no drainage tube is required. The incision is closed by a continuous suture and the ordinary antiseptic dressings are applied, a large mass of wool being put on at the time of the operation so as to act as a splint and keep the parts at rest. When the wound communicates with the mouth, drainage must be employed, and the tubes should be brought out at the most dependent part, one at any rate being made to emerge in the posterior triangle through a button-hole in the skin.

THE TREATMENT OF INOPERABLE CASES.

A patient dying of inoperable cancer of the tongue is in such a pitiable condition that if possible something must be done to relieve him. The

fœtor of the breath, the intense pain, the frequent hæmorrhages and the difficulty in swallowing and sometimes in breathing are sources of the greatest misery.

With the view of avoiding these various troubles, it has been proposed that, even when widespread glandular infection in the neck renders the case inoperable, the disease should be removed from the mouth so as to relieve the patient of these troubles. If this is feasible and the patient can stand the operation, benefit will no doubt result; it is our experience, however, that when the disease can be removed from the mouth without much chance of recurrence, the glands can be taken away also, and the probability, therefore, is that when the glands in the neck are inoperable the disease in the mouth is inoperable too, and thus the question would not arise. Unless the disease can be removed from the mouth with a good prospect of non-recurrence there, the operation should not be done.

When there is marked *dyspnœa*, tracheotomy will be necessary and should be performed comparatively soon. *Dysphagia* is another distressing condition and is due, in most cases, to intense pain on attempting to swallow, and to the fixation of the base of the tongue; in other cases, however, it is caused by the extension of the disease to the pharynx and blocking of the canal. The alternatives to be considered under such circumstances are feeding by tubes, œsophagostomy or gastrostomy, and rectal feeding. Feeding by a stomach tube passed through the mouth is, as a rule, impracticable, chiefly on account of the pain; but when there is no actual disease in the pharynx, the tube may be passed through the nose and may not come in contact with the ulcerated surface. If this is possible, it is the best plan. Failing this, the patient's strength may be maintained for a time by rectal feeding (see p. 257). Œsophagostomy or gastrostomy are seldom worth while. When the disease in the tongue has reached the stage which would necessitate such operations, the patient is generally so far gone that he will not survive long enough for these procedures to be of any value.

The *pain* may sometimes be relieved to a considerable extent by the use of orthoform. The surface of the ulcer is cleansed and dried, and the powdered drug is blown over the surface. Orthoform is not poisonous and therefore the application may be repeated frequently; it should be applied at least half an hour before taking food and its effect often lasts for a considerable time. Other drugs, such as cocaine and morphine, may be given frequently and in large doses in the later stages.

The question often arises as to whether the lingual nerve should be divided in these cases in order to stop the pain. When it can be done successfully, it is of great advantage, but the extent of the disease may render the operation impossible, and even when done it does not always relieve the patient.

Division of the lingual nerve.—The mouth is opened by a gag on the

sound side, and the opposite angle is pulled back with a retractor. The tip of the tongue is seized with forceps and pulled forcibly over to the sound side, when the nerve should start into prominence beneath the mucous membrane just behind and below the last lower molar tooth. If a vertical incision is made through the mucous membrane in this situation, the nerve can be identified, cleared, and a portion excised. At the same time it is obvious that if the growth extends into this region the operation will be difficult or impossible.

The fœtor of the breath should be treated by the frequent use of various antiseptic mouth-washes (sanitas, peroxide of hydrogen, or boro-glyceride), and by powdering the surface of the sore frequently with iodol and touching it occasionally with pure carbolic acid after drying it carefully.

The excessive *salivation*, which is a source of intense discomfort, may be diminished by the administration of atropine.

The *hæmorrhage* often reduces the patient considerably, and it has been proposed to tie the external carotid to prevent this; secondary hæmorrhage is, however, very apt to occur. Styptics are of little use, as they generally cause severe pain and do not check the bleeding materially. In some cases the hæmorrhage may be so severe as to kill the patient almost immediately.

Ligature of both lingual arteries as they come off from the external carotid is sometimes worth doing at an earlier period, as it not only diminishes the risk of bleeding, but exerts a distinct restraining influence upon the growth; in some cases sloughing of a considerable portion of the growth may take place and a cleaner and less painful sore be left behind in the mouth.

Still better than simple ligature of the lingual artery is the injection of boiling water into the branches of the external carotid artery, especially the facial and lingual. When the vessels are simply tied, the blood reaches their terminations by the collateral circulation and the effect produced is only slight. If, however, boiling water is injected, the walls of the smaller vessels are so injured that the blood clots in them and the circulation is completely arrested in that area. The result is partial sloughing of portions of the diseased tissue and atrophy of other parts, and we have seen most remarkable improvement follow this treatment; in some cases, indeed, it has been possible subsequently to remove the remainder of the disease in the tongue. The vessels on both sides should be treated, but a week should elapse between the two operations. The external carotid artery is exposed and its branches defined (see Vol. II. p. 204). A syringe is filled with boiling water, the needle is pushed through the wall of the various branches in turn and the water injected. Before dealing with a fresh branch, the syringe is refilled, as it is essential that the water should be as hot as possible. After the needle is withdrawn the vessels are ligatured on both sides of the puncture. As a rule the

superior thyroid artery is injected as well as the lingual and facial, but this does not seem to be absolutely necessary.

Various other substances such as methyl violet and Coley's fluid have been used, but we cannot recommend them. Nor does radium seem to be of any value; indeed in the cases in which we have seen it used, the disease has seemed to progress more rapidly than before.

CHAPTER X.

AFFECTIONS OF THE FLOOR OF THE MOUTH

RANULA.

A RANULA is a cyst in the floor of the mouth or on the under-surface of the tongue due to dilatation of one of the muciparous glands from blocking of its duct. The blocking of the duct may be due to inflammation about the orifice, or to obstruction by inspissated mucus.

The cyst forms a rounded prominent swelling on one side of the middle line which varies in size from a pea to a plover's egg, and has a characteristic bluish tint, which has been aptly compared to a purple grape. It contains a considerable quantity of mucin and may occasionally be large enough to interfere with the movements of the tongue.

TREATMENT.—*When the tumour is small,* the surface may be painted with a 10 per cent. solution of cocaine, to which are added a few drops of adrenalin chloride, and a little of this solution may also be injected beneath the mucous membrane over the cyst; the mucous membrane over the anterior wall of the cyst is then caught up with toothed forceps, divided, and the cyst removed entire.

When the cyst is large, its complete removal leaves a cavity in the floor of the mouth in which saliva and food collect and undergo putrefaction. The best plan in these cases is to apply cocaine as above, pull up the tongue with tongue-forceps, seize the anterior wall of the cyst in catch-forceps and clip away as much of it as possible, so as to expose the deeper part of the cyst freely. This portion is then sponged over with undiluted carbolic acid or with pure nitric acid on a glass brush; in the latter case the acid is subsequently neutralised by filling the mouth with a solution of carbonate of soda. A strip of iodoform gauze is packed into the cavity and renewed daily until the whole wall is granulating, when further packing is unnecessary. This method generally effects a cure, and it is only when recurrence takes place after it that it is necessary to subject

the patient to the more severe measures required for complete removal of the cyst. If this becomes necessary, it should be done under a general anæsthetic, the cyst dissected out and the raw surface swabbed over with a solution of chloride of zinc (gr. xl. to the ounce).

SALIVARY CALCULUS.

Calculi may be met with in any part of Wharton's duct, but are most common near its orifice. They are generally more or less spindle-shaped, and consist mainly of phosphate of lime with a little calcium carbonate deposited around a nucleus of inspissated mucus. At first the calculus passes unnoticed and the patient's attention is often only called to it by enlargement of the submaxillary gland. This enlargement is due partly to distension of the ducts with saliva and partly to thickening from chronic inflammation; the gland undergoes chronic inflammation from the obstruction to the outflow of the saliva, and becomes enlarged, the enlargement increasing on taking food and often causing much discomfort.

A calculus impacted near the orifice of the duct is easily detected as a hard, elongated mass in the line of the duct, the orifice of which is frequently swollen and reddened. After the stone has remained in the duct for some time, the tissues around become much thickened, and it is sometimes difficult to be certain that the case is not one of tumour, so that it may be necessary to incise the swelling or to introduce a needle into it to make sure. Suppuration may occur behind or around the stone, and a ragged sinus discharging pus, or even an extensive ulcer in the floor of the mouth may be left; through this opening the calculus may sometimes escape. When calculi occur farther back or in the gland itself, the diagnosis is often difficult, and the exact nature of the affection may not be evident until the gland has been cut down upon.

TREATMENT.—The stone should be removed as soon as its presence is diagnosed. *If it is situated near the orifice of Wharton's duct,* the operation is simple and no general anæsthetic is required. The mucous membrane is swabbed with a 10 per cent. solution of cocaine, a few drops are injected in the neighbourhood of the duct and a fine canaliculus director is passed through the orifice, when the stone is struck. In introducing the director it should be held at right angles to the mucous surface until it is well in the duct, when it is inclined backwards and outwards. A canaliculus knife or a very fine tenotome is introduced along the groove of the director, and the orifice of the duct slit up sufficiently for the stone to be extracted. The calculus often shoots out of the duct as the incision is made; if not, it can be removed with a fine pair of sinus forceps. There is little bleeding and there is no need to suture the opening in the duct. A mouth-wash of chlorate of potash (gr. xv. to the ounce) should be used for a few days.

When the calculus lies far back, the operation may be exceedingly

difficult, especially when there is much inflammatory thickening of the tissues around. As the duct passes backwards to the submaxillary gland it lies deeper and deeper in the floor of the mouth, and it comes into close relation with the lingual gustatory nerve which lies on the outer side about the level of the anterior border of the hyoglossus muscle, so that if the incision deviates from the direct line of the duct, the nerve is very apt to be divided, and in several cases this has occurred and led to a troublesome and persistent anæsthesia of one half of the tongue. It is best to operate under a general anæsthetic, as it is almost impossible to control the movements of the tongue if a local anæsthetic is employed. The mouth is opened with a gag, the head is propped up in a good light, or a powerful forehead light is employed, and the tongue is pulled over to the opposite side so as to make the structures in the floor of the mouth as tense and steady as possible. The calculus is then felt for, and is steadied by the forefinger of the left hand pressing it outwards against the ramus of the jaw, whilst the surgeon cuts directly down upon it in the line of the duct. The fixation by the finger should not be relaxed until the stone has actually been exposed, otherwise the parts recede deeply into the floor of the mouth and a second incision may go in a different direction and do damage. When the stone is situated very far back, it is a useful plan to thrust a sharp hook through the mucous membrane of the floor of the mouth beneath the swelling and hook it forcibly upwards and so fix it while it is cut down upon. When the stone has been reached, the duct is slit up sufficiently to enable it to be withdrawn without using any force. The calculus must be examined after removal to see if any portions have been broken off and left behind, and if so they must be searched for and removed, otherwise they may become the nuclei of fresh calculi. The wound in the mouth needs no treatment beyond the use of a mouth-wash of chlorate of potash for a few days. There is generally some interference with the movements of the tongue at first, as a result of the swelling following the operation, but this subsides quickly.

When the calculus is situated in the gland itself, an attempt to remove it from the mouth will not only jeopardise the lingual nerve, but may give rise to dangerous cellulitis, as it necessitates a deep dissection in the floor of the mouth. Moreover, stricture of the duct is apt to occur subsequently from cicatricial contraction. Under these circumstances, it will be best to excise the gland and its duct completely by an external operation, as a simple incision for extraction of the stone would probably be followed by a salivary fistula. The operation is described on p. 103.

DERMOID CYSTS.

Dermoids are not uncommon beneath the tongue and generally occur in the middle line either in the anterior third of the tongue itself or more deeply seated in the floor of the mouth, when they bulge between the jaw

and the hyoid bone and upwards beneath the mucous membrane. They are usually situated between the genio-hyoglossus muscles and above the mylo-hyoid. More rarely they occur far back along the raphe and occasionally are met with to one side below the angle of the jaw. These cysts are sometimes confounded with ranulæ, from which, however, they differ fundamentally. They are thick-walled, situated beneath the mucous membrane, and do not present the purplish appearance characteristic of a ranula. If there is any alteration in the colour of the mucous membrane, it is a somewhat yellowish tinge from the contents showing through the wall. A ranula, on the other hand, is situated partly in the mucous membrane. Dermoids are always deeper and, when large, project into the neck as well as into the mouth.

TREATMENT.—The cyst always requires extirpation, any other treatment being followed by recurrence. When possible, it is best to remove the cyst from the neck rather than from the floor of the mouth, although quite small ones may be removed safely from the latter situation. When they are removed through the neck, the wound is aseptic and heals at once, and the only disadvantage is a slight scar ; this, however, need only be small, as the cyst is easily separated by the finger, and, after having been isolated, can be opened and its contents squeezed out so as to enable it to be removed through a small opening. On the other hand, if the cyst is removed from the mouth, a large cavity is left amongst the muscles, and putrefaction and severe sepsis are likely to occur ; in all cases in which removal from the mouth is performed, it is well to make a counter-opening in the submaxillary region and introduce a drainage tube.

The cyst is best removed through a median incision between the chin and the hyoid bone, the muscles being separated in the middle line. As soon as the cyst is reached, its wall is separated from the surrounding structures by a blunt dissector or by introducing a finger through the wound and sweeping it round the cyst wall. This can usually be done without opening into the mouth, even though the cyst extends right up to the mucous membrane, as there is no adhesion between the two. The cyst is now turned out entire if it is small enough to be delivered through the opening, or if not, an incision may be made into it and its contents squeezed out sufficiently to enable the cyst wall to be pulled through the opening. If the cyst is large and lies deeply among the muscles of the tongue—especially if it is situated in the lateral region of the neck rather than in the middle line—a small drainage tube may be inserted for the first forty-eight hours.

LUDWIG'S ANGINA.

This is a streptococcal infection of the tissues in the floor of the mouth leading to acute cellulitis of the neck of a very dangerous character. The condition usually arises from a sore in the floor of the mouth or the

tonsillar region through which the organisms gain entrance. It is most common in adults, but may also occur in young children, and is a particularly grave and fatal disease.

In a few hours after the commencement of the disease the floor of the mouth becomes hard and brawny, so that the tongue is raised and thrust upwards against the roof of the mouth, whilst the skin in the submental or submaxillary regions becomes indurated and dusky red in colour; the swelling soon spreads to the side of the neck and may extend down to the clavicle. Articulation and mastication are both interfered with, and there may be considerable dyspnœa, partly owing to the swelling of the tissues in the neck, but mainly to the spread of the inflammation backwards giving rise to œdema of the glottis. The temperature is often high at first, but falls later on, and the patient shows symptoms of profound septic poisoning. In the majority of cases a fatal result occurs, often in about three days from the commencement of the inflammation.

TREATMENT.—The only chance in this disease is to adopt early and energetic treatment. In the earliest stages, before the disease is fully established in the cellular tissues of the neck, *antiseptic mouth-washes*, such as sanitas or 1 in 4000 corrosive sublimate, may be of service, and should be employed as frequently and as hot as possible. *Large boric fomentations* (see Vol. I. p. 51) should be applied to the submental and submaxillary regions, and it is well to commence at once by injecting a large dose of *anti-streptococcus serum.* Thirty c.c. of the polyvalent serum should be injected as soon as possible, followed by 10 to 15 c.c. two or three times a day. The mistake generally made is to inject too small rather than too large a quantity. Vaccines do not seem to be of much value. These cases are always due to streptococcal infection and are typical in their symptoms, so that there is no need to wait while a bacterial cultivation is made.

Directly brawniness in the neck is evident, *free incisions* should be made everywhere through the affected part, so as to facilitate the escape of sloughs and pus. Nothing but the freest possible opening up of the affected area is of any use. The incisions should go through the deep fascia in several places and the tissues should be widely opened by the finger and forceps so as to allow of the best possible drainage. The incisions should be planned so as to avoid the important structures in the neck, and where the deeper structures are opened up, Hilton's method (see Vol. I. p. 28) should be used. The wound should be freely sponged over with undiluted carbolic acid, powdered with iodoform and packed with strips of iodoformed gauze. Some advantage seems to be gained by the free administration of citric acid or citrate of potash, the view being that it increases the exudation of serum containing anti-bodies from the wound.

When the disease commences far back in the mouth, it is generally unilateral. It often spreads from one side to the other, however, and

a careful watch must, therefore, be kept on both sides, and the tissues must be opened up on the slightest sign of brawniness. When the tongue itself and the floor of the mouth are brawny, free incisions must be made in that situation also (see p. 56). In doing so care should be taken to avoid the lingual nerve and Wharton's duct (see p. 114). The incisions here should only go through the mucous membrane; the forceps are then used to open up the deeper tissues. On account of the difficulty of drainage, incisions in the mouth should not be made unless definitely called for. The general treatment of diffuse cellulitis (see Vol. I. p. 37) must accompany these procedures; quinine in large doses (gr. xv. three or four times a day) is valuable.

In spite of the free incisions it is not uncommon to find that the obstruction to respiration is so great as to call for intubation or tracheotomy. Whenever it is possible, *intubation* (see Vol. V.) should be preferred, as a tracheotomy wound almost unavoidably becomes infected, especially when the neck has been laid open freely, and septic pneumonia of a most grave type is liable to set in. At the same time, however, intubation is not always feasible as the swelling may not be limited to the glottis, but may occur actually in the larynx. Under these circumstances, we prefer to use a Hahn's or Trendelenburg's tube for the first twenty-four or forty-eight hours, so as to minimise the risk of the introduction of septic material into the air-passages beside the tube.

DIVISION II.

THE SURGICAL AFFECTIONS OF THE PHARYNX AND ŒSOPHAGUS.

CHAPTER XI.

AFFECTIONS OF THE PHARYNX AND TONSILS.

MALFORMATIONS OF THE PHARYNX.

PHARYNGEAL FISTULA.

This is a very rare condition, resulting from incomplete closure of one of the branchial clefts. It is considered in connection with affections of the neck (see Vol. V.).

PHARYNGOCELE.

This term is applied to a condition of pouching of the pharynx, which usually occurs at its lower part and on its posterior aspect just at its junction with the œsophagus ; as the pouch increases in size, it generally passes towards the left side. Food collects in the interior of the pouch and leads to a swelling in the neck which may be emptied on pressure. From time to time the retained food may be vomited in a more or less decomposed condition, and when the pouch is large and full it may actually interfere with swallowing owing to the pressure it exerts on the outside of the pharynx or œsophagus. When the orifice of communication between the pouch and the pharynx is very small, food may not pass into the diverticulum, which may then become distended with air and form a resonant swelling in the neck easily emptied by pressure. The condition is not uncommon and usually occurs in adult males. The congenital origin of these pouches is doubtful, though in some instances muscular fibres have been shown to be present in their wall. In most cases the sac

is composed of the mucous and submucous coats only, which have been protruded through the lower and posterior part of the inferior constrictor of the pharynx, where a weak area is present owing to deficiency of the longitudinal muscular fibres of the upper end of the œsophagus. Other factors which predispose to the formation of diverticula in this situation are the normal, sphincter-like action of the upper end of the œsophagus and in some cases actual narrowing from disease. The exciting causes are injury and the constant pressure of the food in the act of swallowing, the latter leading to the outward propulsion of the mucous pouch.

The condition leads to dysphagia from the entrance of food into the sac, which then presses on and obstructs the œsophagus. The food in the sac also decomposes and causes fœtor of the breath. The result is starvation, or septic pneumonia as the result of the accumulation of putrid material. In some cases ulceration has occurred followed by perforation of the sac with consequent fatal cellulitis.

Diagnosis.—On passing a bougie it is not uncommon to find that at one time a large bougie passes easily into the stomach, while at other times it stops about eight inches from the teeth, the explanation being that in the latter case it enters the pouch. The existence of a pouch can be demonstrated by administering bismuth oxychloride, well mixed with bread and milk. Some of this material will enter the sac, especially if the latter has been previously emptied by external pressure and efforts at swallowing and abstention from food for a day or two. As a result the presence, size, and situation of the sac can be seen on the X-ray screen or in a radiogram. By means of the œsophagoscope the orifice of the opening can also be demonstrated and a bougie can be introduced into the sac. The latter method of investigation, which is somewhat trying to the patient, is not however always necessary.

TREATMENT.—The only method of treatment is by operation, and two procedures have been adopted, viz., excision or invagination of the sac. The great risk of excision is the occurrence of septic cellulitis from infection of the wound in the neck, either during the operation or as the result of subsequent leakage from the pharynx ; this cellulitis may spread downwards into the posterior mediastinum, and generally proves fatal. In most cases, however, this risk can be avoided if the operation is carefully performed. It was with the view of minimising this risk that invagination instead of excision of the sac was suggested, but this is not a good plan, and, if employed at all, should be restricted to very small diverticula. If a large diverticulum is invaginated, it forms a polypus in the œsophagus, which may obstruct the canal and cause dysphagia, and may cause coughing and much discomfort. Protrusion of the sac and reproduction of the original trouble has also occurred after this operation.

Before proceeding to excision of the sac, the teeth and mouth should

be thoroughly cleansed, and if possible the sac should be emptied and washed out by means of a tube, and for a day no food should be taken by the mouth. Half an hour before the operation a subcutaneous injection of morphine (gr. $\frac{1}{4}$) and atropine (gr. $\frac{1}{100}$) should be administered. The head is turned to the right side and a free incision is made along the anterior border of the left sterno-mastoid muscle from the hyoid bone to the supra-sternal notch. The deep fascia is divided and the omo-hyoid muscle is separated from the depressor muscles of the hyoid and pulled outwards or, if necessary, divided. The vessels with the vagus nerve are pulled outwards with a retractor, while the trachea, thyroid gland and depressors of the hyoid are pulled inwards. If the thyroid gland is enlarged the left lobe may require removal, and it may also be necessary to tie and divide the inferior thyroid vessels. The sac is now exposed behind the œsophagus, and if necessary it can be made more evident by passing a bougie into it from the mouth. It is then cleared from its surroundings and its neck defined. If the neck is narrow, it should be tied close to its origin from the pharynx, a clamp applied farther out, and the pouch divided between the ligature and the clamp, swabs being packed around so as to prevent soiling of the tissues ; the sac is then removed. The mucous membrane is scraped out of the stump, and undiluted carbolic acid applied, though some prefer to cauterise it with the thermo-cautery ; in fact it is treated like the stump of an appendix. The next step is to bury the stump by a series of Lembert's sutures or by a purse-string suture. Finally another row of sutures are passed between the muscular coats above and below so as to close the weak spot in the wall of the pharynx.

When the opening into the pharynx is wide and cannot be closed by a ligature the sac must be cut away, the opening closed by sutures, and then the line of incision invaginated by Lembert's sutures and the muscular defect closed as before. A large drainage tube is inserted down to the neighbourhood of the pharyngeal incision in case the latter should give way, and the skin incision is sutured. Some advise a preliminary gastrostomy which is subsequently used for feeding the patient, and is allowed to close after a week. This, however, does not seem to be necessary.

After-treatment.—The patient should be fed by the rectum for three or four days, so as to avoid all chance of endangering the line of union in the pharynx. Instead of this, a tube may be passed into the stomach through the mouth and left in : this is apt to be rather irksome to the patient or it may be displaced by the act of vomiting. At the end of the three or four days, water and liquid foods may be given, and at the expiration of six or seven days soft solids may be commenced. The patient need not be kept in bed for more than four or five days, and during that time the head should be kept as still as possible.

Should the pharyngeal wound give way—as will be shown by saliva

or water escaping through the drainage tube—the patient should be instructed to gargle frequently with boric lotion and to swallow small quantities of it, with the object of keeping the pharyngeal wall as clean as possible and of allowing a certain amount of boric lotion to find its way down through the drainage tube and thus wash it out. If the temperature rises and remains elevated, the wound in the neck should be opened up freely and packed with cyanide gauze ; in addition the drainage tube should be retained.

INJURIES OF THE PHARYNX AND TONSILS.

These are not common, but foreign bodies, such as a pipe-stem, may be driven deeply into the substance of the tonsil or pharynx and cause a *lacerated wound*, or may pass through the wall of the pharynx and injure the vessels outside. The hæmorrhage in these cases may be severe, and usually comes from the tonsillar circle of vessels, composed of the anastomosing branches of the following vessels—the dorsalis linguæ branch of the lingual artery, the ascending palatine and tonsillar branches of the facial, the ascending pharyngeal branch of the external carotid, and the descending palatine branch of the internal maxillary.

TREATMENT.—The patient should be placed in a good light and the mouth opened with a suitable gag. If good daylight is not available, a forehead mirror and an artificial light should be employed. The blood is mopped up with small sponges upon sponge-holders or forceps, and any spurting vessel seized with forceps and tied. If the hæmorrhage merely consists in oozing from small vessels, the best plan is to push a small plug of wool dipped in a solution of adrenalin chloride (1 in 1000) into the wound and hold it there for a short time, when the bleeding will usually cease. In the more serious cases of oozing it may be necessary to hold a sponge firmly pressed against the wound, whilst counter-pressure is made by the finger just behind the angle of the jaw externally. The sponge should be impregnated with a solution of adrenalin chloride or, failing that, tannin or matico, and it may be necessary to keep up the pressure for some hours. A convenient method by which the pressure may be maintained is to pass a suture from one pillar of the fauces to the other by means of a long-handled needle. A piece of sponge to which a string has been securely fixed, so that the sponge cannot be lost, is then placed on the bleeding spot and held in position by tying the ligature. It may be left *in situ* for twenty-four hours, the string hanging out of the mouth ; the stitches are then cut and the sponge removed.

When severe hæmorrhage comes from a deep wound of the tonsil it may be necessary to control the main vessels temporarily before the bleeding can be arrested. If this should be called for, the bifurcation of

the carotid should be exposed in the neck and the external carotid trunk and its branches isolated, especially the ascending pharyngeal branch. If the latter can be picked up and pressure on it arrests the bleeding, it should be tied. If not, the trunk of the external carotid artery should be compressed, and if the bleeding then ceases it should be tied close to its origin so as to include the ascending pharyngeal branch (see Vol. II. p. 204). Should pressure on the trunk of the external carotid artery not control the bleeding, there is probably some wound of the internal carotid artery, which should then be examined and if necessary ligatured, or the wound in it may be sutured ; the latter, however, would probably be a very difficult proceeding on account of the situation of the wound. In attempting suture, the circulation should be arrested by means of Crile's clamps applied above and below the wound in the artery, which is then turned out so as to expose the opening in the vessel. When, however, the case is one of hæmorrhage from a wound in the internal carotid trunk, the patient usually bleeds to death before help can be obtained. Should the patient be seen in time, temporary digital compression of the bleeding point by the finger in the mouth pressing outwards against another pressed well in behind the angle of the jaw should be employed until the patient can be operated upon. Instead of a finger in the mouth, pressure may be made by a sponge or a piece of gauze held in forceps, or by a piece of wood covered with lint.

FOREIGN BODIES IN THE PHARYNX AND TONSILS.

Foreign bodies may occasionally be found in the tonsils, usually in the form of sharp pieces of bone or fish-bones which can be seen on examining the throat in a good light and may be removed with forceps. The foreign bodies in the pharynx are of various kinds. They are generally bodies which are too large to pass into the œsophagus or which are sharp or jagged, and they often give rise to very severe symptoms from their presence in the neighbourhood of the aperture of the larynx. The chief of these are boluses of meat, tooth-plates, pieces of bone or coins.

The *symptoms* will vary according to the size and nature of the object. If it is large—such as a bolus of food—the aperture of the larynx may be blocked, and the patient may die of asphyxia unless relieved immediately. In cases of smaller bodies such as fish-bones, there is constant pain on swallowing, usually referred to a definite spot, and the constant irritation of the foreign body leads to a desire to cough and hawk up mucus. The body can generally be seen with the laryngoscopic mirror or a Killian's tube.

TREATMENT.—When the foreign body is large, and asphyxial symptoms are urgent, a gag of some sort (*e.g.* a piece of wood or the handle

of a knife) should be introduced between the teeth, the finger thrust rapidly to the back of the pharynx, the foreign body felt for, the finger hooked round it and the object removed. This will generally be successful when the obstruction is caused by a smooth substance such as a mass of food. When, however, the body is angular and becomes impacted, as will be the case with a tooth-plate, this method will not suffice and an attempt should be made to remove the body with suitable pharyngeal forceps (see Fig. 40) if they should happen to be at hand, but

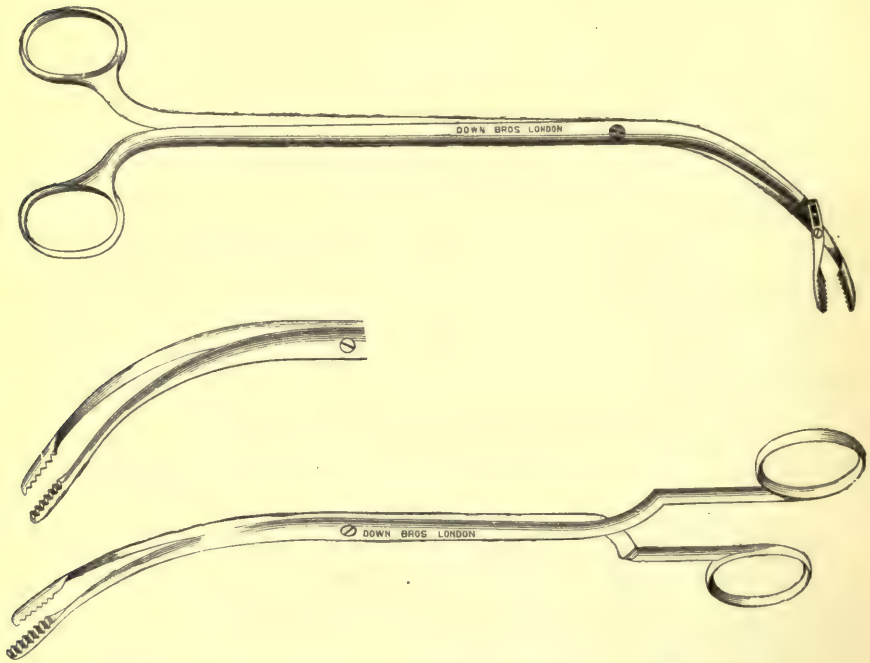


FIG. 40.—FORCEPS FOR REMOVAL OF FOREIGN BODIES IN THE PHARYNX. The blades of the lower pair are flexible and can be bent to any desired curve.

in many cases the asphyxial symptoms will be so severe that laryngotomy (or tracheotomy in a young child) must be performed immediately, and the removal of the foreign body postponed until normal respiration has become established. As soon as possible, a further attempt should be made to dislodge the foreign body; in a young child inversion and vigorous shaking may be effectual in doing so.

In order to remove foreign bodies from the pharynx, forceps with all sorts of curves must be at hand (see Fig. 40), the most useful being those with blades opening in the antero-posterior direction. All attempts should be made under cocaine (10 per cent. solution) with a brilliant illumination. It may be necessary to break up the foreign body

such as tooth-plate, with cutting forceps and remove it piecemeal. In doing this care must be taken to see that none of the pieces find their way into the larynx or down the œsophagus ; they should be grasped in forceps before they are divided. When the instruments are available, Killian's tubes (see p. 164) are very useful, though they are not essential when the foreign body is high up. They should always be used if possible in preference to performing pharyngotomy. When the foreign body is too large or too irregular to be extracted through the tube, it and the tube may be withdrawn together, after the foreign body has been seized by suitable forceps passed through the tube.

Pharyngotomy.—In some instances the impaction may be so firm and the difficulty of getting at the object so great that pharyngotomy is necessary. The anterior triangle is opened and the vessels are freed and pulled out of the way. Whether they are pulled inwards or outwards will depend upon the position of the foreign body ; in most cases they are pulled outwards. Care must be taken not to injure the superior laryngeal nerve, and it is well to introduce a bougie into the pharynx so as to make it more prominent. The pharynx is opened by a clean cut of sufficient size to enable the foreign body to be reached and extracted without undue force. Should the body be irregular and possess sharp hooks, these may be cut off with cutting pliers before removal. In all cases it is essential to avoid bruising of the pharyngeal wall by rough handling. The method of suture of the pharynx and the after-treatment are similar to that for the removal of a pharyngocele (see p. 121).

INFLAMMATORY AFFECTIONS OF THE PHARYNX AND TONSILS.

Inflammatory conditions of the tonsils may be considered under the headings of acute parenchymatous tonsillitis, follicular tonsillitis, tonsillar abscess, acute ulcerative tonsillitis and Vincent's angina.

ACUTE PARENCHYMATOUS TONSILLITIS.

This condition may be unilateral or bilateral, and in it the tonsil is much swollen and the fauces are reddened. It commonly passes off in a few days without suppuration.

TREATMENT.—Little requires to be done. A purge should be given, the patient confined to bed or to a warm room, the throat wrapped up in hot flannel, and a spray of sanitas or Condy's fluid employed. Some of these cases are looked upon as rheumatic, and the administration of ten-grain doses of salicylate of soda three times a day will often relieve the symptoms considerably in those who are susceptible to rheumatism.

FOLLICULAR TONSILLITIS.

This is an affection of the crypts or follicles of the tonsil and is of bacterial origin. It is commonly ascribed to bad hygienic conditions, such as defective drains, dirty bedding, or direct infection by the discharges from the mouths of those suffering from a similar affection. It is particularly liable to occur in those who are the subject of chronically enlarged tonsils.

Symptoms.—The disease is characterised by acute symptoms such as headache and pyrexia, and is marked by the presence of small whitish grey spots upon the tonsils, generally on both sides; these are at first multiple, but may coalesce in patches and form a pseudo-membrane which somewhat resembles that of diphtheria, but differs from it in being easily detached with a camel's hair brush. The diphtheritic membrane is very adherent and usually occurs in a single large patch, which tends to spread beyond the limits of the tonsils, whereas the patches in follicular tonsillitis are small and scattered over the tonsil. There is usually much painful swelling of the glands behind the angle of the jaw, even though the local disturbance is slight.

Prognosis.—As a rule the attack passes off quickly. Although the temperature may be high and the swelling of the glands very marked and very painful at first, the acute symptoms usually subside in four or five days and the glands rarely suppurate. The trouble is, however, extremely liable to recur, especially if the patient is exposed to fresh sources of infection, or if there is chronic enlargement of the tonsils. In view of the latter fact, the enlarged tonsils should be removed after the attack has subsided (see p. 131). Moreover, the enlargement of the glands in the neck should be carefully attended to, as they are liable to become the seat of tuberculous disease unless the inflammation in them disappears under suitable treatment.

TREATMENT.—It is important to try to ascertain the cause of the mischief and to *remove the patient from any insanitary surroundings.* Thus if the drains are defective, the patient should be removed to another house while the defects are being remedied. The possibility of infection from dirty rooms, dirty mattresses or pillows, should also be remembered, and all bedding should be thoroughly cleaned and disinfected. At the same time it is of extreme importance to point out to the patient the distinctly infectious nature of the disease, so that at any rate a certain amount of *isolation* may be practised. The other members of the household, especially children, should be kept away from the patient as much as possible, and infection by kissing, or by using the same eating or drinking vessels, should be guarded against.

In the treatment of the disease itself *a purge* such as calomel (gr. ij. to v.), or mist. alb. (℥iss.), should be given when the patient is first

seen, and *large hot fomentations* (see Vol. I. p. 12) should be applied around the throat and renewed every two or three hours. This relieves the stiffness and pain in the neck considerably. In the ordinary cases the frequent employment of *sprays* of weak sanitas or Condy's fluid, as hot as the patient can bear them, is comforting and relieves the pain on swallowing. In addition to this, *astringent and antiseptic applications* should be made directly to the affected area, and this is best done by painting them on ; a useful fluid is one composed of equal parts of liquor ferri perchloridi, and glycerine ; if this proves too irritating, the proportion of the two may be altered by adding more glycerine. This should be applied every four hours. Another useful paint is composed of glycerine of carbolic acid one part, and water two parts, applied in the same way. A mixture of equal parts of guaiacol and olive oil is also much used. The feeling of stiffness in the throat and the pain on swallowing will be relieved by sucking lozenges containing chlorate of potash and cocaine.

FIG. 41.—SIEGEL'S SPRAY APPARATUS.

In children, in whom the fever is often considerable, liquor ammoniæ acetatis in doses of 2 to 6 drams (according to the age), every four hours may be given until the temperature subsides. In most cases the pain which is provoked by the involuntary swallowing of saliva is so considerable that it prevents the patient from sleeping, and in adults a dose of *opium*, best given in the form of Dover's powder, will be necessary for the first night or two. The patient should always lie upon one side, so as to allow the saliva to run out of the mouth rather than down the throat. When the glands are very tender, any movement of the neck gives rise to pain, and it may be necessary, therefore, to fix the head between sandbags or, in the case of children, to apply a large mass of cotton-wool around the neck so as to restrain the movements.

When the affection is more acute, the iron and glycerine application is, as a rule, too irritating, and glycerinum acidi tannici may be substituted for it. Under these circumstances, too, a soothing and efficacious antiseptic application is a spray containing carbolic acid and tincture of iodine,[1] applied by a Siegel spray apparatus (see Fig. 41) every two or three hours for two minutes at a time.

[1] ℞ Acidi carbol. . . . . ℥ij.
Lin. iodi . . . . . ℥j.
Spirit. vini rect. . . . . ℥ij.
Aq. . . . . ad ℥xij.
Instead of the lin. iodi, the tincture (℥ss.) may be used.

After the patches of exudation separate, small ulcers are left upon the tonsil which usually heal readily. If there is any delay, they may be brushed over with a solution of nitrate of silver (gr. xx. to the ounce) every morning. After an attack of follicular tonsillitis the patient is generally considerably pulled down in health, especially if the attack has been a severe one, and hence during convalescence it will be necessary to order light nourishing food, and to provide if possible a change of air. As soon as he has recovered, the tonsils should be removed if still enlarged (see p. 131).

SUPPURATIVE TONSILLITIS.

This condition—popularly known as 'quinsy'—is an acute inflammation of the tonsil with suppuration around it. The pus forms above and in front of the tonsil, and spreads towards the soft palate, though occasionally it forms behind or external to the tonsil. As a rule there is an acute tonsillitis on both sides, whilst the suppuration occurs on one side only, or, if bilateral, it appears on one side before the other. The temperature is very high, the swelling may almost block the aperture of the fauces, and the glands behind the jaw are large, painful, and may suppurate. There is considerable swelling of the neighbouring portion of the pharynx and soft palate, and generally also œdema of the glottis. The symptoms; on the whole, are very similar to those of other forms of inflammation of the tonsils, only much more severe. The pain, especially on any attempt to swallow, is very intense.

TREATMENT.—Abortive treatment usually fails to prevent suppuration, but may relieve the patient considerably. It is well to begin with *a saline purge* (mist. alb. ℥iss.). Some surgeons used to place great faith in the administration of *tincture of aconite* given in minim doses, repeated every hour for four or five doses until the pulse rate approached the normal. It is well to administer ten-grain doses of *salicylate of soda* every four hours. *Large hot fomentations* changed every two or three hours should be applied to the neck to relieve the pain, while *steam inhalations* are employed for the relief of the pain on swallowing. Gargles, as a rule, are out of the question on account of the severe pain, but a spray of a saturated solution of *bicarbonate of soda* in a Siegel's apparatus is valuable if there is an unduly free secretion of tenacious mucus which interferes with the patient's comfort. When this secretion is not excessive, *the carbolic acid and iodine spray* (*vide supra*) is useful, as, apart from its antiseptic action, the carbolic acid is a useful sedative.

Suppuration is usually evident about the third day, and watch should be kept for its occurrence. The pus generally points in the soft palate just above the tonsil, and it may escape through the supra-tonsillar fossa. These tonsillar abscesses should always be opened.

When the suppuration is situated above the tonsil, the surgeon will be guided as to the right time to open the abscess by the amount of swelling

and œdema of the soft palate. When the disease has lasted for three or four days or the swelling is increasing, the presence of pus may be assumed, and even should none be present, the incision will act usefully in draining the parts. Local anæsthesia is all that is necessary, a 10 per cent. solution of cocaine being swabbed over the proposed seat of incision with a small pledget of wool on forceps; this is a better plan than employing a spray, as the patient does not swallow the drug. An incision is made through the mucous membrane of the soft palate just external to and above the centre of the swelling. A narrow-bladed knife similar to that used for paring the edges of a cleft palate should be employed; a narrow-bladed bistoury, guarded up to within half an inch of its point by wrapping it in strapping so as to avoid injuring the tongue, may be used when the other is not at hand. The blade should be introduced with its edge inwards and turned with its edge downwards when it reaches the soft palate. The point of the knife should be directed inwards. The incision should be about a half to one inch in length, large enough to allow the pus to escape freely. Some surgeons recommend that the knife should only be used to incise the mucous

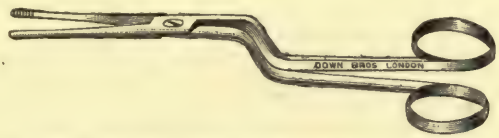


Fig. 42.—St. Clair Thomson's Forceps for opening a Peri-tonsillar Abscess.

membrane, and the operation completed by pushing a pair of forceps (see Fig. 42) into the soft palate in a line parallel to the last molar teeth, taking great care to avoid pushing the points outwards into the neck. When the abscess cavity is entered, pus appears, and the blades are separated widely so as to insure the free escape of the pus without any need for subsequent drainage; the head should be depressed so as to allow the pus to run out of the mouth and not down into the throat. The pus may be at some little distance beneath the surface of the mucous membrane, and it is therefore advisable to feel for the softest spot, either by means of the finger or the forceps, before making the incision. The mouth should be washed out immediately afterwards with boric lotion.

When the abscess is situated in the substance of the tonsil it may be incised by a bistoury (*vide supra*) thrust into it in a line with the last molar teeth. If the knife does not strike the abscess at once, the incision should be enlarged by pushing sinus forceps into it. When the pus is reached, it is evacuated by forcibly opening up the abscess cavity with the forceps.

After-treatment.—These cases usually recover rapidly after the abscess has been opened, and little in the way of after-treatment is required.

For the first day or two it is well to use an antiseptic spray, of which the carbolic and iodine solution (see p. 127) is perhaps the best. As soon as the swelling has subsided a little, the patient will be able to gargle with sanitas or chlorate of potash. The same treatment with regard to the administration of tonics, food, and fresh air, is applicable to this condition as to follicular tonsillitis (see p. 128).

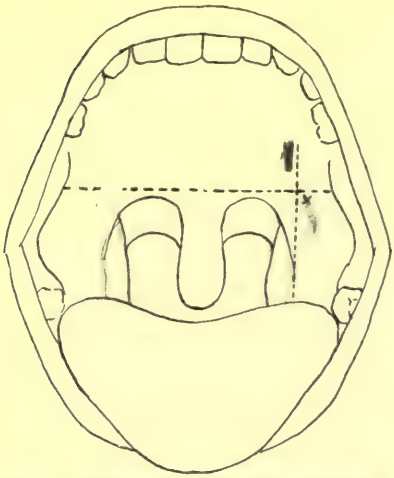


FIG. 43.—DIAGRAM TO ILLUSTRATE THE POINT AT WHICH TO OPEN A PERI-TONSILLAR ABSCESS. The point X is the junction of a line drawn horizontally across the base of the uvula with one prolonging upwards the anterior pillar of the fauces. (From *Diseases of the Nose and Throat*, by Sir St. Clair Thomson.)

ACUTE ULCERATIVE TONSILLITIS.

This is an inflammatory condition of the tonsil and fauces, frequently accompanied by ulceration, on the surface of which there may be a slough. It is common amongst those who work in hospitals, and in that case goes by the name of 'hospital sore throat.' A bacteriological examination should always be made; the usual organism present in these cases is a streptococcus.

TREATMENT.—This should be on the lines laid down for follicular tonsillitis (see p. 126); special importance attaches to the application of astringents and antiseptics to the lesion in the throat. Equal parts of liquor ferri perchloridi and glycerine may be painted on three or four times a day, whilst a solution of nitrate of silver (gr. xx. to xl. to the ounce) may be brushed over the ulcer every morning with advantage. The employment of a vaccine of the organism present may be of benefit. The disease is of an infective nature and may be followed by Ludwig's angina if neglected. It is of primary importance in the treatment to remove the patient from the surroundings in which he has contracted the affection, otherwise remedial measures may be used in vain. Good hygienic conditions, nourishing food and the administration of port wine, are important; a short holiday in the country is of the greatest advantage.

VINCENT'S ANGINA.

This is the most serious form of acute tonsillitis and occurs especially in children. It is described by Vincent under two types, an ulcero-membranous and a diphtheroid variety. The organisms supposed to be the causal agents are a fusiform bacillus and a spirillum. It is the disease sometimes described as pseudo-diphtheria. In both forms the patient

is very ill and in the ulcerative form extensive ulceration may occur covered with a grey or yellowish false membrane, and in the diphtheroid form this membrane is more consistent and may attain a considerable size. The breath is fœtid, there is dysphagia and some fever, and the submaxillary glands enlarge. The illness lasts from four to eight days. As distinguished from diphtheria, the onset is more sudden, the temperature higher, there is rarely albuminuria, there are no late paralytic sequelæ, and the Klebs-Lœffler bacillus is not present.

TREATMENT.—The treatment is much the same as that for ulcerative tonsillitis. The patient should be isolated from other children as the disease seems to be infective. Aconite is recommended, purges, aspirine, liquor ferri perchloridi (10 to 20 minim doses), rest in bed and nutritious diet. The throat may be painted with carbolic acid in glycerine, with alkaline solutions, with 4 per cent. protargol, Listerine, or iron and glycerine, and hot fomentations should be applied to the neck.

CHRONIC ENLARGEMENT OF THE TONSILS.

This is a common affection and the enlargement may occur without any previous acute inflammation; it may follow one of the exanthemata and may remain after an attack of acute tonsillitis. It is frequently associated with the presence of adenoid vegetations in the naso-pharynx and many of the symptoms attributed to the tonsillar affection are really due to the presence of adenoids. The affection is one of great importance, because the enlarged follicles of the tonsil harbour all kinds of organisms, and hence the patient is constantly liable to acute attacks of follicular tonsillitis and also to tuberculous glands in the neck. Moreover the affection may hinder proper respiration and so interfere with nutrition in general.

TREATMENT.—(*a*) **Palliative.**—When the enlargement of the tonsils is not very marked and the patient is strongly disinclined to have them removed, palliative measures may be employed, such as painting the tonsils with equal parts of glycerine and liquor ferri perchloridi, with glycerinum iodi, or with glycerinum acidi tannici, together with the administration of cod-liver oil and iron. Good hygienic conditions and good food are essential. The enlargement seldom subsides under palliative treatment, however, until the natural atrophy which occurs at puberty sets in.

(*b*) **Operative.**—When the enlargement is marked, and especially when symptoms of imperfect respiration, such as thick speech, nasal voice or snoring at night, are associated with it, or when the patient is subject to repeated attacks of 'sore throat,' removal, not only of the tonsils but of the adenoids, should be strongly advised.

Removal of the tonsils is carried out at the present time either by means of the guillotine or by complete enucleation. When the guillotine

is employed, only the projecting part of the tonsil is shaved off, but as a rule most of the open crypts are taken away. It is not uncommon, however, for recurrence of the enlargement to take place, and a second or third operation may be necessary. When, on the other hand, complete enucleation is practised, recurrence does not of course take place, but the operation is more serious and prolonged, and it has only been extensively practised quite recently, so that its possible effect, more especially on the singing voice, can hardly be gauged as yet. When adenoids are removed at the same time it is usual to begin by taking away the adenoids and then to deal with the tonsils; the trouble with bleeding is generally less when this sequence is followed.

Removal by the Guillotine.—The best guillotine for this purpose is Mackenzie's (see Fig. 44). The ring into which the tonsil is received is variously shaped, being sometimes circular for tonsils that are not unduly elongated in any particular direction, and sometimes oval, with its long axis either horizontal or vertical for tonsils that are especially enlarged in either of these directions. Unless the patient is a young child, no assistance is required, but in the young it is necessary to have some one to keep the mouth open with a gag and also to make counter-pressure over the tonsil and to hold the head. This can be done by the anæsthetist when an anæsthetic is employed. The tonsillotome is introduced with its flat surface parallel to the dorsum of the tongue until it reaches the back of the pharynx, when it is turned so that the tonsil is received into the ring of the instrument. If the operation is done without an anæsthetic, care should be taken to avoid touching the tongue as the instrument is passed in, and the parts should be anæsthetised by painting with a 10 per cent. solution of cocaine. As the tonsil is received into the ring of the instrument, the assistant presses firmly inwards beneath the angle of the jaw so as to steady the tonsil and push it well into the loop. The surgeon then manipulates the instrument so as to press its end firmly outwards against the pharyngeal wall, the handle being carried towards the opposite side of the mouth, and he then pushes the cutting blade home sharply with the thumb. This movement, although momentary, requires care to avoid tilting or rotating the instrument as the blade is pushed home. Unless the tonsillotome is held absolutely steady, its end is apt to be deflected inwards and a portion of the tonsil will escape. Especial care

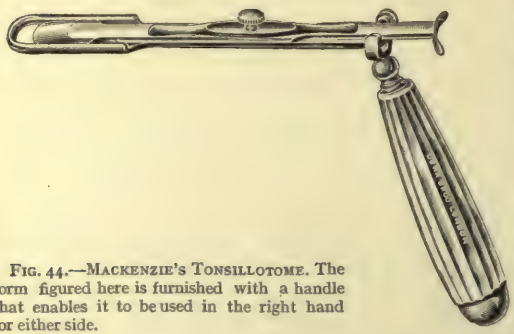


FIG. 44.—MACKENZIE'S TONSILLOTOME. The form figured here is furnished with a handle that enables it to be used in the right hand for either side.

must be taken to hook the guillotine round the lower border of the tonsil. If the operation is done under a general anæsthetic, a gag should be used, and the whole procedure can be carried out by the sense of touch rather than by sight, the forefinger of the other hand being introduced into the mouth to see that the ring of the instrument is properly in position. When no general anæsthetic is used, a good light is essential. The anæsthesia should not be pushed too deeply ; the reflex act of swallowing should remain, so as to prevent blood passing into the larynx.

The left tonsil is easily removed in this manner, and if the surgeon is ambidextrous an exactly similar procedure can be carried out upon the right side. If he is not ambidextrous, he must either have an instrument with an interchangeable handle, so as to enable him to remove the right tonsil with the right hand, or he must stand somewhat behind and to the side of the patient, and introduce the tonsillotome from that position. Removal of the tonsils should be done as rapidly as possible ; no attempt should be made to stop the bleeding from the first tonsil before attacking the second. If done sufficiently quickly, the second tonsil can be removed before any considerable bleeding has had time to occur from the first, and attempts to check the bleeding before proceeding to the second operation merely serve to obscure the view and to give the patient's courage time to evaporate.

Hæmorrhage after tonsillotomy is rarely severe and usually stops on sucking ice, or the application of ice, or by temporary sponge pressure. Should the bleeding be so severe as to demand something more, the surface may be painted over with supra-renal extract or with some styptic, such as tincture of matico or liquor ferri perchloridi (for methods of using styptics, see p. 122). A few cases have occurred in which the bleeding has been arterial and profuse and has, indeed, proved fatal. In all cases of bad bleeding the mouth should be opened widely with a gag in a bright light, and any spurting vessel looked for and, if seen, caught and tied. In other cases similar measures must be adopted to those already described on p. 122. Injury to the internal carotid artery has been described as a result of this operation, but this accident is practically impossible when a tonsillotome is used, and it is hardly likely to happen, even when the other methods are employed.

Removal by Enucleation.—In this operation the tonsil is shelled out of its bed by means of the finger or some suitable instrument. It is especially indicated in cases of shallow, flat, broad tonsils, especially when they are small and closely adherent to the adjacent tissues. It is also the best method when there has been recurrence of the enlargement after a previous operation with the guillotine or when that instrument cannot be satisfactorily employed, or when the tonsil is so diseased that complete extirpation would appear to be the only satisfactory method of treatment.

A general anæsthetic is necessary and the tongue is pulled forwards, so that the tonsil is fully exposed. The tonsil is seized by a volsella or

ring forceps (see Fig. 45) and held steadily in position. By means of a pair of curved blunt scissors the mucous membrane is then divided above

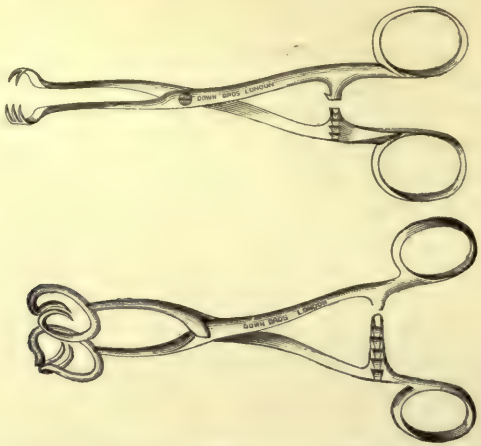


FIG. 45.—VOLSELLA FORCEPS. The upper pair are useful for firm flat tonsils; the lower for the larger friable ones. Another form of forceps is shown in the following figure.

the tonsil until its capsule is reached, when the forefinger is inserted and the tonsil and its capsule separated from the pharyngeal wall in a direction

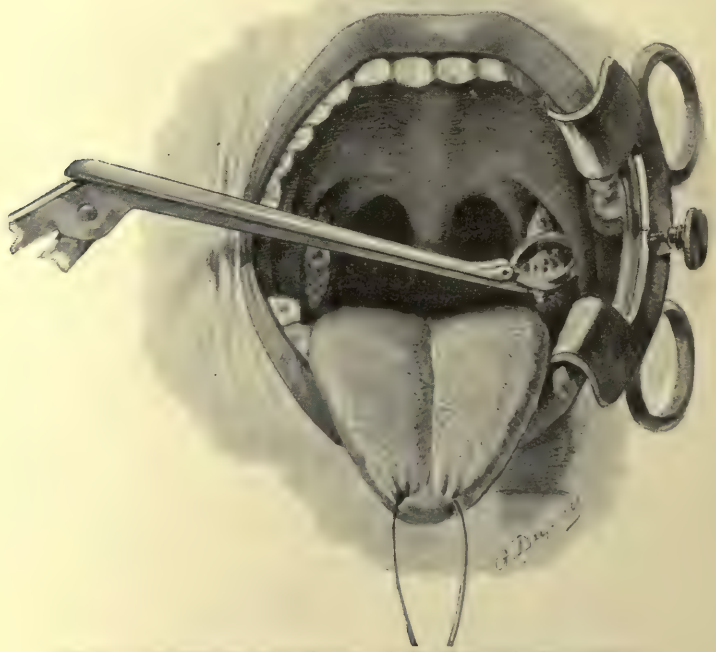


FIG. 46.—ENUCLEATION OF THE TONSIL. *Pulling forward the gland.—Waugh.*

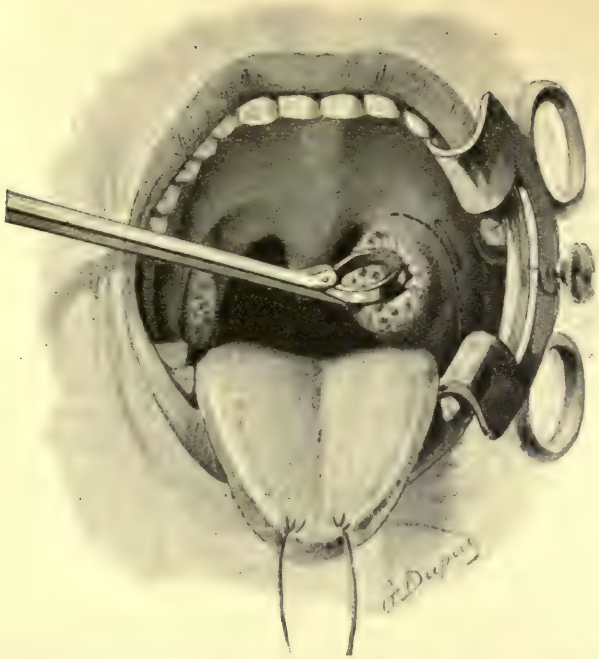


FIG. 47.—ENUCLEATION OF THE TONSIL. *The incision.* The arrow shows the direction in which the knife is carried.—*Waugh.*

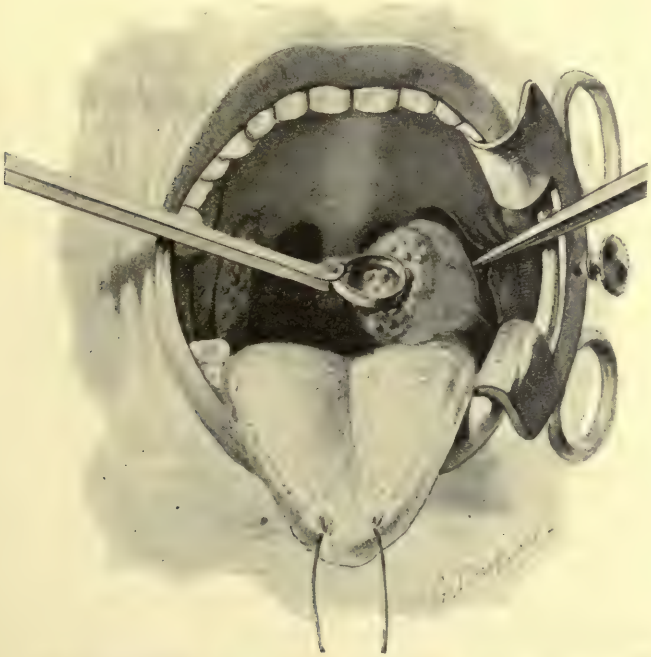


FIG. 48.—ENUCLEATION OF THE TONSIL. *Completion of the enucleation.—Waugh.*

downwards and inwards. The mucous membrane at the sides of the tonsil generally tears through, but at the lowermost part it may be necessary to divide it with scissors (see Figs. 46–48). In some cases the operation is easy: in others it is very difficult. The tonsil may be very friable and break into small pieces. The degree of anæsthesia required is greater than that for the ordinary guillotine method, and on this ground alone the operation has been very adversely criticised, especially for children. It is, however, gaining in favour.

After-treatment.—The patient should be kept indoors for a day or two and confined to his room so as to avoid cold. Before performing an operation such as tonsillotomy, the hygienic conditions of the house should be inquired into, for if the operation is done in a house in which the drains are defective, serious septic sore-throat is apt to follow. As a local application some mild antiseptic gargle, such as chlorate of potash and boric lotion, is all that is required. Soft food should be given for the first four or five days.

POST-NASAL ADENOID GROWTHS.

We are indebted to Dr. H. Lambert Lack, Surgeon to the Throat Department of the London Hospital, for the following paragraphs.

Adenoids are most common in children, but are met with up to thirty, or even later, and they tend to atrophy during adolescence. They may be hereditary; distinct evidence of former adenoids such as deafness, malformation of the jaws, and open mouth are often seen in the parents of adenoid children. They are more common in cold, damp climates and amongst certain races, such as the Hebrews. The most common exciting causes are nasal catarrhs, the exanthemata, diphtheria, sore throats and whooping cough.

Pathology.—The growth is a hypertrophy of the normal lymphoid tissue of this region and forms a mass in the vault of the naso-pharynx; from this mass two bands usually extend downwards and to each side and become lost behind the posterior pillars of the fauces. Isolated nodules of lymphoid tissue are also seen lower down in the pharynx and occasionally extend on to the upper part of the nasal septum. Not uncommonly masses are found filling Rosenmüller's fossæ (the deep depressions in the lateral wall of the pharynx behind the Eustachian tubes), and these masses may be adherent to the lips of the tubes.

Symptoms.—The presence of adenoid growths may be productive of various troubles. There is a great susceptibility to repeated attacks of 'cold in the head,' catarrh, and obstruction of the Eustachian tubes, and, in the more severe cases, to recurrent attacks of suppurative otitis. The obstructed nose renders mouth-breathing necessary, and children who have adenoids may be generally recognised by the open mouth and the stupid expression, which may be actually associated with ineptitude for

mental exertion. The obstruction to respiration is more marked during sleep, when the mouth is closed by the approximation of the tongue to the palate. Consequently the child's sleep is broken, he suffers from 'night-terrors,' and on waking he is not refreshed, but complains of headache and giddiness. As a result of broken sleep and deficient oxygenation of the blood, the general health suffers, the child becomes anæmic, wasted and stunted in growth. In infants or in growing children the difficulty of breathing may also give rise to 'pigeon-breast' or to well-marked depressions in the epigastric or the lower sternal regions.

The open mouth necessitated by nasal obstruction produces marked deformity of the jaws. The upper jaw is ill-developed, the palate is high and narrow, the alveolar arch V-shaped, the teeth crowded and irregular. There may be protrusion of the upper incisors producing an overhung or open bite. Similar but less marked changes occur in the lower jaw. Among the more remote consequences may be mentioned a short barking cough and a tendency to laryngitis, bronchitis, and probably to other pulmonary complications. Attacks of croup, asthma, hay fever, incontinence of urine, epilepsy, etc., have all been ascribed to adenoids. Although they depend primarily upon other causes, improvement may sometimes follow removal of the adenoids.

TREATMENT.—The first point to decide is the question of operation—whether the case may be treated for a time with palliative remedies or whether it is better to remove the growths at once. This question must be decided by the severity of the symptoms which can be fairly ascribed to the presence of the growths, and not by the amount of growth present. Marked improvement may follow the removal of a very small growth; on the other hand a large growth sometimes produces no symptoms of importance. The operation is by no means severe, and if any of the symptoms above enumerated be present, it is better to remove the growths. In other cases expectant treatment may be advised, and if the patient is able to take precautions, in many cases the necessity for operation will not arise and the growths will atrophy as the child grows older.

Palliative.—The object is to place the child under the best hygienic conditions and to keep him free from catarrh. Under such circumstances adenoids may give rise to no symptoms. The best plan is to send the patient to the seaside, to keep him as much as possible in the open air and to attend carefully to his diet. A warm, bright, dry place should be chosen, and cold and damp avoided. Suitable tonics such as cod-liver oil and the syrups of the phosphate or iodide of iron should be prescribed.

Operative.—The risk of operation is probably very slight. The dangers to be guarded against are those arising from the anæsthesia, hæmorrhage, asphyxia from blood entering the air-passages, septic pneumonia from the same cause, sepsis and especially acute suppurative otitis with its complications.

The anæsthetic.—In adults, especially if the growths be limited to a large central pad, nitrous oxide anæsthesia is sufficient. When, however, there are other hypertrophies, such as enlargement of the posterior ends of the inferior turbinates, a more prolonged anæsthesia is necessary, and for this purpose gas followed by ether or a mixture of chloroform and ether is probably the best. A prolonged anæsthesia is always advisable when operation is undertaken for the relief of marked deafness. In the majority of cases in *children* it is best to give one of the anæsthetic mixtures, such as the A.C.E. or the C.E. mixture, and the anæsthesia may be completed by giving pure ether by the open method. The anæsthetic may be carefully pushed until the palate is sufficiently relaxed to enable the operation to be easily carried out, but at the same time the cough reflexes should not be abolished and the patient should be able to swallow the blood as it accumulates in the pharynx. This method allows three or four minutes' good anæsthesia, which is usually sufficient, but if necessary it may be

Fig. 49.—Modified Gottstein's Post-nasal Curette.

Fig. 50.—Juracz's Post-nasal Forceps.

prolonged by giving chloroform through a Jünker. In giving the anæsthetic, the existence of nasal obstruction must be remembered and therefore free mouth-breathing must be allowed, and a gag inserted if necessary.

The instruments.—For the removal of the growths a post-nasal curette —such as some modification of Gottstein's—a ring knife and adenoid forceps are required. The points to be attended to in choosing the curette are that its top cutting edge should be fairly strong and not too thick, and that it should be attached by two bars which are parallel and which do not meet at an angle as in many of the instruments (see Fig. 49). It may be provided with a hook or cage to catch the growth, and it is well to have curettes of different sizes. The best forceps is some modification of Löwenberg's, such as Juracz's (see Fig. 50).

The operation under gas.—In this method the patient is usually anæsthetised sitting upright in a dental chair, but the supine position may be used if preferred. The patient should face a strong light or, better

still, should sit in the same position with regard to a lamp as for an ordinary laryngoscopic examination, and the light should be reflected into the throat by means of a frontal mirror. The anæsthetic having been given, the dental prop is changed for a powerful gag and the mouth widely opened. Unless a good view of the growths has been previously obtained it is well to commence the operation by inserting the index finger of the left hand well up into the post-nasal space in order to examine the site of the growth, and see whether or not it spreads on to the Eustachian cushions, and also to ascertain the existence of hypertrophy of the posterior ends of the inferior turbinates. The curette is passed well up behind the soft palate until it touches the lower part of the nasal septum. It is then pressed upwards and backwards, keeping the blade in contact with the posterior edge of the septum, until the roof of the naso-pharynx is reached. The curette being now in position, it is necessary to see that the handle is exactly in the middle line. Then whilst firmly pressing backwards, the handle of the instrument is sharply raised, the blade swept down over the posterior wall of the naso-pharynx, and the major portion of the growth is cut off in one piece. This curette with the growth attached is removed, the smaller instrument introduced and three or four rapid sweeps made over the post-pharyngeal wall. The finger is again introduced to ascertain that the operation is complete. In some cases the growth will be found to have been left hanging by a small thread of mucous membrane, and directly the patient comes out of the anæsthetic this will set up violent coughing and retching ; it must always be sought for and can be easily removed with a pair of forceps, aided if necessary with the scissors. The bleeding is usually free for a second or so, but rapidly ceases and requires no special treatment.

The operation under chloroform.—The operation should be performed with the patient lying down, either on a flat table or with a small pillow beneath the head. The position with the head hanging down over the end of the table has no advantages ; it is more difficult and takes more time to remove the growths thoroughly in this position ; and the chief danger of the operation—asphyxia from entrance of blood into the upper air passages—is probably greater, as the veins in the neck are congested and the hæmorrhage is thereby increased. Also in this position the throat is narrowed, its capacity for holding blood is less, and it is more difficult to introduce the finger. With the patient lying flat, the operation can be performed more easily and more quickly. Should any trouble arise from obstructed breathing—which will only occur when the anæsthesia has been pushed too far—the patient should be immediately rolled over on to his face, when the blood will run out of the mouth and throat and the breathing will be at once relieved.

The surgeon must stand facing and on the right-hand side of the patient, and it is well to operate upon a low couch or table so that the surgeon stands well over the patient. The left forefinger is introduced

into the post-nasal space and passed up on each side into Rosenmüller's fossæ so as to separate the growth from the lips of the Eustachian tubes and the sides of the naso-pharynx. The curette is then introduced and the growths removed as above described.

Should the growths in Rosenmüller's fossæ be very tough, or difficult to get at, their removal can often be effected with a Meyer's ring-knife introduced through the mouth. This may be used as an ordinary curette; the cutting-blade being sharp, it is a very effective instrument. In some cases small pieces of growth at the upper part or sides of the space, or partially detached pieces of growth, may be most easily seized and removed by adenoid forceps guided by the finger.

After the adenoids have been removed, the posterior ends of the inferior turbinates should be examined with the finger and, if enlarged, a piece should be removed with the snare or with cutting-forceps such as

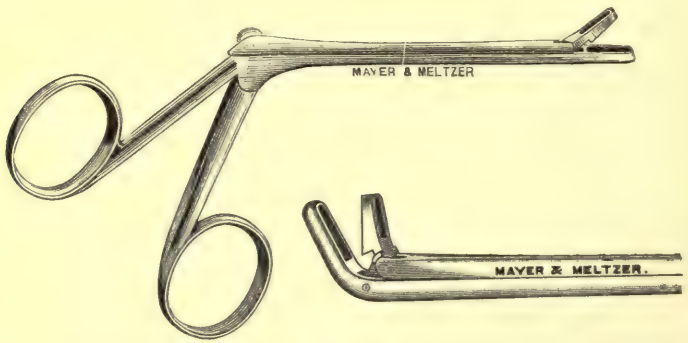


Fig. 51.—Grünwald's Nasal Cutting Forceps.

Grünwald's (see Fig. 51). The instrument is guided by the tip of the left index-finger. Next, the tonsils, if enlarged—as they so commonly are in association with adenoids—should be removed with the guillotine. Some surgeons prefer to remove the tonsils at the commencement of the operation, but this is not to be recommended. The removal of the adenoids is more easily accomplished during the earlier and deeper stage of the anæsthesia, and the bleeding after tonsillotomy is more sudden and profuse, and therefore it is better delayed until the patient shows signs of coming out of the anæsthetic.

The hæmorrhage that occurs during the operation is usually somewhat free, but it soon ceases. As a rule the patient swallows the blood, but, should it accumulate in the back of the pharynx during the operation, the throat may be sponged out or, better still, the patient should be rolled over on to his side and the mouth wiped out. Should blood enter the larynx or trachea, the patient must be immediately rolled over on to his face and the head lowered; if this be done in time, and the anæsthesia

be not too deep, the blood will soon be expectorated and the dyspnœa will pass off. Should the patient become cyanosed, the throat should be vigorously sponged out to excite a reflex, and the finger should be pushed down into the larynx to remove any clot that may be within reach. In extreme cases the child must be inverted, and artificial respiration adopted, and, should this fail, tracheotomy will be necessary; this fortunately is an extremely rare event. Immediately the operation is finished, the patient is rolled over on to his face, the mouth is sponged clean and the gag loosened, as the stretching of the mouth tends to maintain the hæmorrhage.

After-treatment.—The patient should be kept in bed for one or two days, after which he may be allowed to get up and, if fine, may go out of doors about the third or fourth day. The first food given after the operation should always be cold for fear of exciting hæmorrhage; but after twenty-four hours in children, and usually after forty-eight in adults, ordinary food may be given. As a rule it is not well to bother the patient with any active after-treatment, but the nose and ears should always be carefully examined. At the first sign of inflammation of the drum or of increase in deafness a blister should be applied to the mastoid region and the nose should be washed out with a simple alkaline lotion. Moreover, if at any time a bloody or muco-purulent fœtid discharge collects in the nose or throat it should be syringed away with a solution of boric acid. Should there be any hæmorrhage, an ice-cloth should be applied to the face and ice given to suck; if it be really profuse or prolonged, it may be necessary to check it by means of the tannic and gallic acid paste. It is generally advisable to give the child a good purge on the second night to clear away any ill-effects of the blood which has been swallowed.

Results.—The result of the operation is nearly always extremely good. The difficulty in breathing usually disappears after a few days and the deafness, if due to Eustachian obstruction, also rapidly recovers. In some cases, however, these symptoms require further treatment. Other symptoms are more slow to go; but the habit of keeping the mouth open, the peculiar speech, the facial expression, etc., all generally disappear in time, especially if the parents take pains to teach the child. The improvement in the general health is frequently remarkable.

If the removal be thorough, recurrence will be very rare; but after imperfect operations, recurrence is common. The younger the patient the greater is the risk of recurrence, especially if the patient subsequently suffers from one of the acute exanthemata, from repeated sore throats or nasal catarrhs. With children under the age of seven a guarded prognosis must invariably be given with regard to this point, but in patients over ten it may be stated with some confidence that the growths will not return, if the operation has been done with care and thoroughness.

CALCULI OF THE TONSILS.

Collection of mucus and calcareous material may occur in the tonsillar crypts and occasionally give rise to calculi, containing chiefly phosphate and carbonate of lime. Leptothrix masses are often present, and occur in the crypts of the tonsils, especially in the supra-tonsillar fossa. They often cause very few symptoms and are recognised as whitish projections from the surface of the tonsils. They may, however, lead to attacks of inflammation or severe stabbing pain.

TREATMENT.—The tonsillar crypt can generally be easily cleared out with a sharp spoon of convenient size. Should there be any difficulty in doing this, should the collections be numerous, or should recurrence take place, it is best to shave off the surface of the tonsil with a tonsillotome (see p. 132).

ACUTE PHARYNGEAL ABSCESS.

The pharynx consists essentially of a fibrous bag or framework, to which the name of pharyngeal aponeurosis is given. Internal to this is the mucous membrane which is supplied with abundance of lymphoid tissue and numerous mucous glands. The mucous membrane is continuous with that of the other cavities which open into the pharynx. The muscles of the pharynx are outside the aponeurosis, and are separated from those on the front of the bodies of the vertebræ by the strong prevertebral fascia, which stretches from one sterno-mastoid muscle to the other. Behind this fascia and resting on the prevertebral muscles are the retro-pharyngeal glands, which are well developed in children, but may be absent in later life.

The only acute inflammatory affection of the pharynx which needs a separate description is suppuration following an acute pharyngitis, which generally occurs in young children. This is really an abscess in the sub-mucous or lymphoid tissue of the pharynx, and is in the wall of the pharynx. Difficulty in swallowing occurs early, and is accompanied by considerable pain ; examination of the throat shows that the dysphagia is caused not by a diffuse inflammatory condition of the mucous membrane, but by a localised swelling. The prominence usually occurs in the pharyngeal cavity, and it may be situated laterally. The condition is serious and if the abscess is of any size it interferes considerably both with deglutition and respiration. If left alone it bursts spontaneously into the throat and there is some danger that the patient may be asphyxiated if this occurs during sleep.

TREATMENT.—The abscess should be evacuated as soon as possible. This is easily done from the pharynx, and the cavity heals as rapidly as does that of any other acute abscess.

When asphyxia is imminent in a case of acute pharyngeal abscess, or

the swelling projects markedly into the pharynx, it may not be feasible to give an anæsthetic. Under these circumstances the child should be firmly pinioned in a blanket or jack-towel and held almost inverted, or at any rate with the head very low, while a suitable gag such as Doyen's (see Fig. 27) is introduced. The forefinger of the left hand is then passed well back over the dorsum of the tongue, which is depressed and hooked forward out of the way, and a cleft-palate knife, or a guarded bistoury (see p. 129) with the cutting edge downwards is plunged into the abscess cavity in the middle line so as to open it freely. The escape of the pus from the mouth is facilitated by the above position ; pus can hardly find its way into the air passages.

After the operation it is only necessary to have the back of the throat sprayed or swabbed out frequently with sanitas or Condy's fluid.

ACUTE RETRO-PHARYNGEAL OR PREVERTEBRAL ABSCESS.

This is due to acute suppuration in the lymphatic glands in front of the prevertebral muscles. The posterior pharyngeal wall is displaced forwards by the swelling, which is usually situated to one side of the middle line.

TREATMENT.—The abscess should be opened from behind the sterno-mastoid muscle in the manner described below, and a drainage tube inserted into the cavity.

CHRONIC (TUBERCULOUS) RETRO-PHARYNGEAL ABSCESS.

Chronic tuberculous abscesses occur at the back and sides of the pharynx and are usually the result of tuberculous disease of the cervical vertebræ. Sometimes, however, they may be due to suppuration in tuberculous post-pharyngeal (prevertebral) glands. The abscess pushes forwards the posterior pharyngeal wall and narrows the throat and may be large enough to interfere with swallowing and breathing ; it may be situated to one side. If left alone, it extends into the neck, but before long it may burst into the pharynx, giving rise to a septic tuberculous sinus. This is especially the case when the abscess depends upon disease of the spine ; a painful foul ulcer is then formed on the posterior pharyngeal wall, with a pouch behind it in which septic material collects, and the patient goes steadily downhill.

TREATMENT.—If the abscess is opened from the outside, the contents washed out and iodoform emulsion injected, it does as well as a chronic abscess elsewhere, and it may also be possible to get at the tuberculous focus in the spine and to treat it appropriately, removing sequestra and scraping out the cavity. Under no circumstances whatever should a chronic abscess of this kind be opened from the pharynx. Even when there is considerable dyspnœa, there is always time to open the

abscess from the outside ; there is not the same urgency as in the case of acute abscess. When the affection is due to spinal disease, great care is necessary in moving the head when the patient is under the anæsthetic, otherwise serious damage may be done.

Operation.—An incision is made just behind the posterior border of the sterno-mastoid, commencing above at the mastoid process and running downwards for about an inch and a half. This incision is deepened until the deep fascia is opened behind the muscle, the posterior border of which is hooked up with a retractor ; some enlarged glands may require removal before the posterior border of the sterno-mastoid muscle can be defined. The finger is then introduced into the wound and feels for the transverse processes of the cervical vertebræ, and a blunt dissector is gradually insinuated behind the vessels until the abscess cavity is reached ; this is facilitated by keeping one finger upon the abscess in the mouth so as to ascertain the right direction in which to work. If the instrument is kept close to the anterior surface of the transverse processes and made to bore directly into the abscess cavity, no difficulty is encountered and the abscess can be opened in a few seconds. The channel is enlarged by introducing a pair of dressing-forceps along the dissector and carefully expanding the blades in the vertical direction. The finger may then be insinuated into the abscess cavity and the state of matters explored. Hæmorrhage rarely occurs during the operation, but if it does it is venous and ceases as soon as the pus is evacuated. The cavity should be scraped out with a flushing-spoon, great care being taken not to exercise any pressure against the pharyngeal wall lest perforation should occur. If the case is one of spinal disease, the bone may also be scraped and any sequestrum which is present removed. Iodoform and glycerine is then injected, the wound stitched up, and the treatment appropriate for the spinal disease gone on with (see Vol. III. p. 294).

The abscess should never be opened through the anterior triangle as is sometimes recommended. It is extremely difficult to reach the abscess cavity by this route, as the vessels have to be carefully defined and pushed out of the way, and considerable bleeding and a tedious operation may result.

GRANULAR PHARYNGITIS.

This condition is marked by enlargement of the lymphoid follicles at the back and sides of the pharynx ; it is often associated with enlargement of the tonsils and adenoid vegetations in the naso-pharynx. The condition is common in public speakers, and is one of the most frequent causes of the affection known as ' clergyman's sore-throat.' Its principal symptoms are perversions of sensation in the pharynx, cough, hawking-up of mucus, hoarseness, a feeling of tiredness and sometimes loss of voice.

TREATMENT.—*When the follicles are much enlarged,* an effectual method is to destroy them with the electric cautery. The posterior wall of

the pharynx should be brushed over with a 10 per cent. solution of cocaine, the back of the pharynx is brightly illuminated and a fine electro-cautery point is pressed against one of the enlarged follicles, and the current turned on. This is repeated on six or eight follicles at a sitting, and at intervals of four days or so, until all the enlarged follicles are destroyed. In the meanwhile, some slightly astringent gargle should be employed, and the patient should use his voice as little as possible.

When the follicles are not markedly enlarged, as is the case when the trouble is due to excessive smoking, or dyspepsia, the best treatment is to apply glycerine of tannic acid, or glycerine and tinct. ferri perchloridi (one part in three), over the affected area three times daily with a large camel's-hair brush. Relief may also be obtained by inhalations of chloride of ammonium or by menthol sprayed through the nose by an atomiser.

ATROPHIC PHARYNGITIS.

A more rebellious form is the atrophic pharyngitis, which is generally associated with atrophic rhinitis, and is secondary to that condition. There is much tenacious mucus in the pharynx, which feels constantly dry; when examined, the pharynx presents a glazed reddish appearance streaked with black crusts.

TREATMENT.—A weak alkaline solution, such as carbonate of soda (gr. xx. to the ounce), syringed through the nostrils three or four times daily, is often useful. Inhalations of chloride of ammonium, spraying the throat with menthol, or painting it with glycerine and borax may also be tried in turn.

SYPHILIS OF THE TONSIL AND PHARYNX.

The tonsil is one of the commonest seats of a **primary chancre** in the mouth. The *treatment* is similar to that of primary chancre elsewhere. The injection of salvarsan (see Vol. I. Chap. XI.) is especially indicated owing to its effect in causing rapid healing of the sore. Locally the sore may be powdered with calomel and starch (one part in three).

In **secondary syphilis** the tonsil is frequently the seat of the congestion that occurs in the early stage, and also of mucous patches. The latter spread from the tonsil over the soft palate and the uvula and, although they may ulcerate in the centre, their raised white edge is quite characteristic.

Here again the *treatment* must be that of secondary syphilis. Occasionally very severe suffering is caused and there is extreme dysphagia from the presence of these ulcers on the fauces. Under these circumstances salvarsan should be injected intravenously or the patient should be placed as rapidly as possible under the influence of mercury, either by the use of inunctions or by intramuscular injections (see Vol. I. Chap. XI.).

Locally calomel and starch powder are of great value, or the ulcers may be painted with chromic acid solution (gr. x to xx to the ounce) after having been carefully dried.

The **tertiary forms** are the most serious on account of the rapid destruction of tissue often caused by them, and they are common on the pharynx as well as on the soft palate. Gummata form and break down rapidly, leading to deep ulceration of the mucous membrane. Unless the condition is arrested quickly, the ulceration may extend and lead to extensive cicatrisation and stenosis of the pharynx. The soft palate may become adherent to the posterior pharyngeal wall, and may thus obstruct or entirely obliterate the connection between the naso-pharynx and the pharynx proper.

In **congenital syphilis** similar lesions are not very uncommon.

Immediate and energetic *treatment* is called for on the lines laid down above.

During healing every effort should be made to prevent stenosis of the pharynx and adhesion of the soft palate, but it must be admitted that this is excessively difficult. Bougies should be passed frequently into the naso-pharynx, but if the ulceration has extended on to the edge of the palate it is almost impossible to prevent considerable closure.

STENOSIS OF THE PHARYNX.

This affection may be due to a variety of causes, of which congenital or acquired syphilis is by far the most frequent ; it follows burns, scalds, the action of corrosive substances, and ulcerations such as lupus. It is most common in the upper part of the pharynx and is generally associated with adhesion of the soft palate to the posterior pharyngeal wall. Slight adhesions in that situation may not give rise to marked difficulty either in deglutition or articulation, but both these actions are affected when the adhesions are extensive, the patient having a pronounced nasal voice, and deglutition being very difficult ; the food constantly returns through the nose owing to imperfect action of the soft palate. Should the stenosis affect the lower part of the pharyngeal wall, deglutition may be interfered with in another way ; there may be some degree of actual stenosis, giving rise to a condition very similar to stricture of the upper part of the œsophagus.

TREATMENT.—The treatment of adhesions of the palate and stenosis of the pharynx is very difficult. When the palate is adherent there is a constant tendency to recurrence in spite of repeated operations to divide the adhesions, and no plastic operation is likely to be entirely successful. All that can be done under the circumstances is to divide the adhesions between the palate and the pharyngeal wall with scissors or a blunt-pointed bistoury, taking care to do this slowly so as to avoid the possibility of doing damage to vessels which may have been dragged

out of position. After the operation, the palate must be kept from contracting fresh adhesions if possible by the frequent use of blunt instruments, bent to a suitable curve, passed into the pharynx and swept between the palate and the posterior pharyngeal wall. This may be done by the patient himself if necessary, and in the early stages should be repeated twice daily; later on, once a day or every other day suffices. If it causes much pain, cocaine anæsthesia may be employed. The stricture, however, is almost invariably reproduced, to some degree at any rate.

When there is stenosis of the pharynx, the case practically becomes one of stricture of the upper part of the œsophagus, and bougies will have to be passed as for that affection (see Chap. XII.). This treatment must be persisted in for the rest of the patient's life. Sometimes, as the result of syphilitic ulceration, the stenosis of the pharynx is fairly high up, and consists rather in obstruction to the passage of food by bands and diaphragms than in any uniform contraction. Under these circumstances, benefit may be obtained by dividing these obstructions. The greatest care must be taken in doing so because important vessels, such as the lingual or the carotid trunks, may be dragged inwards by the contraction and may be endangered by the operation. The best plan is to nick any contracted bands, and then to stretch the structures so nicked until sufficient dilatation is produced; for this purpose general anæsthesia is necessary. A direct vision œsophagoscope is inserted down to the stricture, and a long-handled knife is passed through it and made to divide the adhesions or bands, after which bougies of different sizes are used to dilate the lumen of the stricture.

The *after-treatment* of these cases is very difficult, and when the stenosis is high up in the pharynx, the ordinary œsophageal bougie is not large enough to keep the pharynx properly dilated. In some of the cases of which we have been speaking it may be necessary to employ a specially made dilating instrument with a suitable curve, and blades which can be separated by means of a screw handle, or two or three bougies may be inserted at the same time. It may be necessary also to give the patient an anæsthetic from time to time and repeat the division of the stricture.

TUBERCULOSIS OF THE TONSIL AND PHARYNX.

Tuberculosis may affect the tonsil and the pharyngeal wall. It is, however, rare except in connection with enlarged tonsils, when there may be no ulceration, and is usually associated with tuberculous disease of the lungs or larynx. Lupus sometimes occurs in this region independently of lung disease. Tuberculous ulcers are generally shallow, unhealthy in appearance and covered with a dirty yellowish layer which is partly exudation and partly degenerating tissue. In the case of lupus nodules are frequently seen in the neighbourhood of the ulcers. The

glands are usually enlarged and caseous, and the ulcers cause the patient intense pain on swallowing. Death generally occurs before long from exhaustion.

TREATMENT.—The *general treatment* suitable for tuberculosis (see Vol. I. p. 231) must be adopted, and it is hardly ever worth while to adopt any radical treatment, even were it feasible, since the ulceration is usually accompanied by advanced tuberculosis elsewhere. Tuberculin injections (see Vol. I. p. 522) should be used.

The *local treatment* is mainly directed to the relief of pain, and this is best done by blowing orthoform on to the ulcerated surface about half an hour or more before meals. Should orthoform fail to relieve the pain, a 25 per cent. solution of menthol in parolein in an atomiser, or a spray containing cocaine or morphine, may be used.

If the ulceration is limited and the patient's general condition is good, the ulcers may be scraped with a sharp spoon after cocainising the surface thoroughly. This is particularly called for when the pain on swallowing is intense. Should this fail to give relief, pure lactic acid may be brushed over the ulcerated surface every day for a fortnight or longer; the surface of the ulcer should be well cocainised before the application as it often causes intense pain. As a result, healthy granulation may be produced and the ulcer usually ceases to cause much pain, although it may not cicatrise. Should the pure lactic acid fail, the ulcer may be touched once or twice a week with undiluted carbolic acid; besides its antiseptic action, the acid has a powerful anæsthetic effect.

Stenosis may follow the cure of this affection and may call for appropriate treatment (*vide supra*). Unless there is actual ulceration, no local treatment is required; should it be necessary, it will be similar to that just described.

TUMOURS OF THE TONSIL AND PHARYNX.

These are best considered together because a malignant growth arising in the tonsil constantly tends to encroach upon the neighbouring part of the pharynx and *vice versâ*.

BENIGN TUMOURS.

Papillomata may occasionally be found about the margin of the fauces and the uvula. **Adenomata** are not infrequently met with on the soft palate and were at one time mistaken for carcinoma. **Myomata, fibromata,** or **lipomata** are very rare and do not give rise to any trouble except by their bulk. Sometimes, however, these tumours—and especially the myomatous form which occurs somewhat lower down in the pharynx—become pedunculated and give rise to a pharyngeal polypus which interferes with deglutition and, if large, with respiration.

TREATMENT.—A small tumour of this kind will probably pass

unnoticed and does not therefore call for any treatment. When, however, it assumes a pedunculated form, attention is drawn to it, and sooner or later it will be necessary to remove it.

Of sessile tumours.—When the tumour is not markedly pedunculated it may be possible to incise its capsule and shell out the growth. This may be done from the mouth when the tumour is high up and can be seen properly. When situated lower down an œsophagoscope will be required ; failing that, it may be necessary to perform pharyngotomy (see p. 125) in order to obtain a good view of the tumour. When operating upon a tumour of this kind, whether from the inside or the outside, it is necessary to carry the incision through the capsule down to its lowest point so as to ensure good drainage, otherwise septic discharges will accumulate at the bottom of the capsule and decompose, just as occurs when a retro-pharyngeal abscess is insufficiently opened from the mouth.

Of pedunculated growths.—When the growth is pedunculated it may be removed by passing a ligature around its base and snipping off the tumour. This may be done either through the mouth or after pharyngotomy (see p. 125), according to the situation of the tumour and the length of the pedicle. If the tumour is situated high up and can be seen easily from the mouth, the patient is placed under a general anæsthetic, the mouth opened with a gag, the tongue firmly depressed, and the pedicle of the tumour exposed. A stout silk ligature threaded through the eye of a probe which is bent to a suitable curve is then passed around the base of the growth, the ligature tightened, the polypus seized with a pair of volsella forceps to prevent it slipping down the throat, and the pedicle cut through. Should the pedicle be thick, it may be necessary to transfix it with an aneurysm or hernia needle and ligature it in two parts.

As a rule any of these growths can be dealt with from above, an œsophagoscope being used when they are low down : pharyngotomy is seldom required.

After-treatment.—For the first week or ten days gargles of sanitas or Condy's fluid should be employed and the patient should be restricted to semi-solid food. The ligature usually separates within the first week and there is no risk of secondary hæmorrhage.

MALIGNANT TUMOURS.

These may be either sarcomatous or epitheliomatous.

SARCOMATA.—These growths usually occur as lympho-sarcomata of the tonsil. They are much rarer than epitheliomata, but their prognosis is bad ; like the carcinomata they lead to enlargement of the glands in the neck. At first they remain limited to the tonsil and give rise to no definite symptoms ; they may even attain a large size before being noticed. Later on, they cause difficulty in deglutition and are often deeply ulcerated ; free hæmorrhage of a most alarming character may occur

from them. The tumour usually grows extremely rapidly, and fills up the entire pharynx. The interference with breathing and swallowing is increased by the constant collection of tenacious mucus at the back of the throat.

Treatment.—This consists of early removal both of the growth and the enlarged glands. The methods of operating and the after-treatment are similar to that for carcinoma (*vide infra*).

EPITHELIOMATA are met with in any part of this region. They frequently spread from the back of the tongue to the anterior pillar of the fauces and the tonsil; in other cases they spread in the reverse direction, commencing in the tonsil and subsequently infiltrating the tongue. They may also spread from the tonsil to the soft palate. When they commence at the lower part of the tonsil, or when they spread from the tongue to that situation, they rapidly extend downwards and involve the aryteno-epiglottidean folds and side wall of the pharynx. Sometimes the tumour is entirely pharyngeal, and in that case it usually commences fairly low down just behind the tonsil. Lastly, the anterior pharyngeal wall may sometimes be affected, the growth occurring behind the cricoid cartilage either as a primary mass or as a secondary extension from the larynx.

As in the sarcomata, the symptoms may be very slight, even though the tumour has attained a considerable size. In some cases, the first thing to attract the patient's attention is the presence of an enlarged gland in the neck, and there may be a large mass of hard fixed glands secondary to a small growth, which is situated in some remote and almost invisible portion of the pharynx. The glands involved are those situated in the upper part of the anterior triangle of the neck, and those deep to the sterno-mastoid muscle.

Treatment.—In connection with the treatment of both sarcomata and epitheliomata various points arise.[1] In the first place the advisability of performing an operation at all must be considered and after that the method by which it should be done.

The advisability of operating at all must be decided partly by the extent of the disease and partly by its situation. The more extensive the growth, the less favourable is the result of operation, especially when the disease is in the pharynx. Extensive enlargement of the glands in the neck is not however a serious bar to operation, as we have already pointed out in connection with cancer of the tongue (see p. 77), because the glands may be successfully removed, even if large and adherent to the carotid sheath. *The extent of the disease in the throat*, however, is a very different matter. If the patient survives an extensive operation a large wound is left which secretes pus for a long time, and distortion of the

[1] The question of operation in malignant disease of the pharynx and its results will be found fully discussed in the Lettsomian Lectures for 1896 by W. Watson Cheyne.

pharynx with stenosis is likely to occur after healing and to interfere seriously with the patient's comfort. Further, the disease is liable to spread superficially along the pharyngeal mucous membrane for a considerable distance beyond any tangible induration, and therefore the probability of immediate recurrence is great.

The situation of the disease is most important, especially its relation to the orifice of the larynx. When the latter is free, the operation is more favourable than when the epiglottidean folds have become involved. In the latter case, the great majority of patients operated upon die of septic pneumonia, because it is almost impossible to avoid the leakage of septic material into the air-passages. Hence in cases of this kind it is probably better to extirpate the larynx as well as the affected portion of the pharynx, should an operation be decided upon.

Operations for malignant disease of the pharynx are very discouraging, especially on account of the serious risks immediately following them, but these risks may be considerably diminished by taking certain precautions. The chance of recurrence is also no doubt very great, but that is a risk common to all operations for cancer, and in cases of small malignant tumours of the pharynx and tonsil the results in this respect are not very much worse than those after operations on cancer elsewhere. Since the sufferings that these patients must undergo in the final stages are extreme, it seems justifiable to give them the chance afforded by operation in suitable cases. The operation should never be strongly pressed upon the patient, however, and all sides of the question should be explained to him. We should recommend that, if the operation involves complete removal of the larynx as well as removal of the affected portion of the pharynx, the patient should be advised not to undergo it, as no description can make him realise the deplorable condition in which the operation, even if immediately successful, will leave him. Poor patients would probably be condemned to spend the rest of their lives in the workhouse, and the operation therefore merely offers a prolongation of their misery. Of course it is possible that a patient of a literary disposition, who is well off, might find other compensations in life, even though suffering from the tremendous disadvantage that the deformity entails; but on this point he must be left to judge for himself.

The chief dangers of the operations and their prevention.—The chief dangers of these operations are sepsis in the neck and septic pneumonia. In practically all cases the anterior triangle must be opened up, not only for the excision of the disease in the pharynx, but also still more extensively for the removal of enlarged glands; an acute diffuse cellulitis spreading in the planes of the cervical fascia is not uncommon after the operation.

With the view of avoiding sepsis in the neck, it is only natural to ask whether it is not possible to remove the glands from outside whilst the

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pharyngeal disease is removed from within the mouth without establishing a communication between the two wounds. Owing to the anatomical condition of affairs this is unfortunately seldom possible. Another precaution would be to divide the operation into two stages, in the first of which the glands are removed, whilst in the second the wound is opened up again sufficiently to give proper access to the pharynx. This undoubtedly renders the second operation more troublesome than if both were done at the same time, and, apart from the question of sepsis, there is the risk of the wound becoming infected with cancer cells in the vicinity of the disease in the throat during the interval between the two operations. We are therefore in favour of performing the whole operation at one sitting.

Prevention of septic pneumonia.—Septic pneumonia may be guarded against, to some extent, in various ways. The first precaution is the

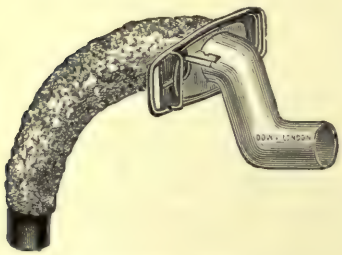

FIG. 52.—HAHN'S CANNULA.

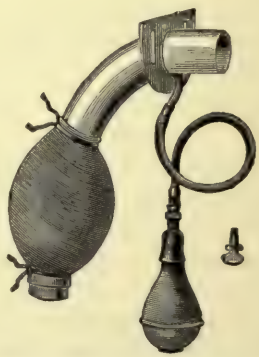

FIG. 53.—TRENDELENBURG'S TAMPON CANNULA.

performance of a *preliminary tracheotomy.* When the orifice of the larynx is not involved and can be packed off during the operation, a laryngotomy may suffice.

The object of performing tracheotomy is not only to allow the patient to breathe, but also to prevent blood and discharges running down the trachea. Since the pharynx can seldom be plugged as is done for operations on the tongue, a Hahn's or a Trendelenburg's tube must be employed. The Hahn's tube is surrounded by compressed aseptic sponge, which swells up and blocks the trachea for the time being (see Fig. 52). The Trendelenburg tube is surrounded by an india-rubber casing which can be blown up, so as to fill up the trachea (see Fig. 53). The disadvantage of the latter is that the air is apt to leak out and the closure to become imperfect ; its advantage is its cleanliness. The disadvantage of the Hahn's tube is that the sponge becomes saturated and blood may leak down, and on removing it, fluid is squeezed out and runs down the trachea. The latter trouble can be avoided, to some extent, by placing the patient in the Trendelenburg

position before removing the tube, and also in some cases by packing the larynx above the tube during the operation. It is a question whether the tracheotomy should not be done a week or more before the excision, so as to allow the trachea to become accustomed to the presence of the tube. There is, certainly, some advantage in this ; but it is seldom safe to delay the removal of the malignant disease for even that period.

The intratracheal method of administering anæsthetics (see p. 33) may obviate the necessity for tracheotomy and keep the trachea free more efficiently.

Keen, of Philadelphia, strongly advocates the employment of the Trendelenburg position both during and after the operation. We have not found any practical advantage in this, and the position is very irksome to the patient.

A procedure that we consider of the greatest value in avoiding septic pneumonia is to *close the opening into the pharynx* after the removal of the disease if that is possible, or if not to *sear the cut surfaces of the pharynx with a thermo-cautery*. We always attempt to stitch up the pharynx so as to prevent the large wound in the neck adding to the amount of discharge in the throat, and also to facilitate swallowing. The pharyngeal wall is very extensile and it is sometimes possible to bring the edges together in cases suitable for operation. The stitches must be so arranged that the mucous surfaces of the pharynx do not curl outwards, otherwise union will not occur. An attempt is made to invert the mucous surface by catgut sutures and these are buried by sutures corresponding to Lembert's sutures as used in the intestine. We generally employ this double row of sutures, the outer row not penetrating the pharynx. Even if union fails, it does not matter much so long as the stitches hold for two or three days, so that the critical period for the patient, when he is unable to swallow or clear his throat properly and while the external wound has not yet granulated, is tided over. A large raw surface in the throat at a later date is not of serious importance.

Besides these precautions we also adopt all the preliminary measures recommended for operations for cancer of the tongue (see p. 81).

Drainage.—We always drain these wounds from outside, inserting a large drainage tube close up to the line of the incision in the pharynx and bringing it out at the most dependent spot in the wound in the neck. Should the fat and glands have been removed from beneath the sterno-mastoid, a button-hole is made through the skin in the posterior triangle and a second tube is brought through it. Before closing the wound in the neck it is well to sponge it out with a solution of chloride of zinc (gr. xl to the ounce).

Arrest of hæmorrhage.—In our earlier operations we were accustomed to tie the external carotid artery, but experience has shown that this is not only unnecessary but is a grave source of danger. When the wound in the throat communicates with that in the neck, the seat of ligature is

exposed to sepsis, and the risk of secondary hæmorrhage is consequently extremely great. Indeed, the collected cases of various surgeons show that the majority of those in which the external carotid has been tied under these circumstances have died from secondary hæmorrhage. Experience shows that the bleeding during the operation is not so severe as to necessitate this procedure and, with a preliminary tracheotomy and the use of Hahn's tube, it need not give rise to any anxiety. The operation should be so planned that the access to the tumour from the outside is good and that the surgeon is enabled to see and seize the bleeding points as they are divided. It is seldom necessary to employ temporary compression of either the common or external carotid.

The methods of gaining access to the primary disease.—No definite incisions or precise methods can be laid down for these operations, as the surgeon must plan out the operation for each individual case. We shall, however, endeavour to indicate some of the chief points in connection with them.

Removal from within the mouth—The disease can very rarely be removed without an external incision, or at any rate without making the incision in the throat communicate with that for the removal of glands in the neck ; if this can be done, however, the operation is a much safer one. As an example we may quote a small epithelioma at the junction of the soft palate and the upper part of the tonsil which does not infiltrate the tissues deeply, or an epithelioma on the anterior pillar of the fauces or towards the front of the tonsil, or some cases of small epitheliomata occurring at the edge of the tongue with a tendency to extension on to the anterior pillar of the fauces. We have removed growths in all these situations from the mouth without opening the neck.

Splitting the cheek.—Access to the disease in this situation is greatly facilitated by splitting the cheek. No doubt removal can sometimes be effected without doing this, but we should not advise that procedure. To split the cheek from the angle of the mouth to the anterior border of the masseter does not add to the gravity of the operation, nor does it cause much subsequent deformity, especially in the male, while it renders the disease about the anterior pillar of the fauces or the velum palati much more accessible.

Removal by the thermo-cautery.—We have come to the conclusion that the thermo-cautery is the best method of removing the growth in the cases above referred to. Not only is there little bleeding, but the heat of the cautery destroys any cancerous epithelial cells which may be spreading superficially, and thus adds an additional safeguard against recurrence. At the same time the operation leaves an eschar from which there is little exudation, so that there is not nearly the same amount of discharge at first as there would be from a clean-cut wound. The disadvantage is that the edges of the wound cannot be stitched together ; but, as we only recommend the cautery for small growths,

away from the larynx, this is not of importance. The best plan is to mark out the area to be removed with a fine thermo-cautery point. If this is done the surgeon can make quite sure of removing the disease completely when the tissues become subsequently unrecognisable from the burning. Any glands in the neck can be dealt with immediately before the disease in the mouth is removed, the wound being stitched up and covered with gauze while the mouth operation is in progress.

After-treatment.—Antiseptic gargles, such as sanitas or Condy's fluid, should be used for ten days or a fortnight. The food should be fluid at

FIG. 54.—DIVISION OF THE LOWER JAW IN REMOVAL OF A CANCER OF THE PHARYNX. The shaded part of the mandible denotes the portion that is removed.

first and may be introduced by a tube passed backwards along the sound side of the mouth: the food may also be given through a nasal tube if the above plan does not succeed. The patient soon regains the power of swallowing.

Removal through the neck.—In the majority of cases the disease must be reached from outside. In the first place the glands must be removed from the anterior triangle in all cases, and this is best done by an incision along the anterior border of the sterno-mastoid from the lobule of the ear down to the lower part of the neck. From this vertical incision another should be carried along the hyoid bone and curved upwards nearly to the lower border of the jaw over the anterior end of the submaxillary triangle (see Fig. 54). These flaps are dissected up, and the anterior and submaxillary triangles are cleared out (see p. 101); in most cases the jugular vein should also be removed. The digastric muscle should be thoroughly exposed as the tumour is in close contact

with it. The subsequent proceedings will vary with the situation of the growth. When it is on the lateral wall of the pharynx it will be immediately beneath the finger just below the digastric muscle, and all that is necessary is to retract the vessels and expose the pharyngeal wall, taking care to avoid injuring the superior laryngeal nerve. An incision is then made into the wall of the pharnyx to one side well away from the growth, and the disease cut away with curved scissors, the wound in the pharynx being afterwards sutured as described on p. 153.

When the disease is situated higher up, especially when it is in the tonsillar region, freer access is necessary. When the lower portion of the tonsillar area is affected, the digastric and stylo-hyoid muscles should be divided, taking care to leave the hypoglossal nerve intact, and the jaw is pushed well forwards so as to expose the tonsillar region. The pharynx is then incised behind the growth and well free of it at a point best ascertained by introducing the finger into the mouth. The disease in the pharynx is thus exposed and can be removed.

When the disease runs fairly high up it may suffice to split the cheek as far out as the masseter in addition to the procedure just described, so as to detach the upper part of the disease satisfactorily from above.

When, however, the disease extends high up and affects the whole of the tonsillar region, it is better to divide the lower jaw. Curiously enough the mortality in the cases in which the lower jaw has been divided is considerably less than those in which it was not done. The reason seems to be that secondary hæmorrhage was more frequent in the latter cases, probably from imperfect ligature of vessels at the operation owing to the less perfect exposure of the wound. The jaw may be divided in front of the masseter or above the angle. When the jaw is divided in front of the masseter the whole tonsillar area and side of the pharynx are exposed to view after the posterior belly of the digastric and the stylo-hyoid muscles have been cut across, and the disease can be removed as easily as if it were upon the surface. In this operation the soft parts are dissected well up before the jaw is sawn through.

When the disease is situated farther back, the jaw may be divided above the angle, leaving the attachment of the masseter below, and it is a good thing to remove the ascending ramus of the jaw (see Fig. 54). If the angle and the ascending ramus are removed, the functional result is bad, as the jaw is pulled to that side ; but if the division is made above the angle, the ascending ramus may be removed without causing much disability and an excellent view of the operation area is obtained when the jaw is pulled well forwards. In some rare cases Langenbeck's division of the jaw (see p. 95), already referred to in speaking of cancer of the tongue, may be of value ; usually, however, it is not necessary to have such an extensive incision.

When the tumour is situated about the base of the tongue, the disease may be readily got at from outside by removing the great cornu of the

hyoid bone and opening the pharynx in that situation, taking care to avoid the superior laryngeal nerve. This exposes the base of the tongue and the epiglottis, and the latter and a wedge-shaped portion of the tongue may be removed, while at the same time the glands in the anterior triangle of the neck are dissected out.

Sub-hyoid pharyngotomy.—Another method of gaining access to the upper part of the pharynx is by making a transverse incision through the thyro-hyoid membrane close to the hyoid bone. The latter structure is then pulled up, the thyroid cartilage pulled down, the epiglottis divided and the pharynx opened. Care must be taken not to injure the superior laryngeal nerve by prolonging the incision too far backwards ; the nerve may be avoided by keeping close to the cornu of the hyoid bone, but it runs considerable risk. This operation only gives good access to disease about the epiglottis or the aryteno-epiglottidean folds ; in disease of the tonsil and the lateral wall of the pharynx the parts are exposed more thoroughly by one of the methods already described.

After-treatment.—If a preliminary tracheotomy has been performed and a Hahn's tube employed, a clean one should be substituted immediately after the operation. This is changed after twelve hours, and while this is being done, the head is kept hanging down in order to prevent septic material running down the trachea. After thirty-six hours an ordinary tracheotomy tube is substituted for the Hahn's cannula and kept in for two or three days. For the first three days it is well to feed the patient by the rectum (see p. 257), but after that food is given by the mouth, the head being kept hanging over the bed and turned well towards the sound side, whilst the food is taken in small sips and very slowly ; if taken in this way it runs down the sound side of the throat without interfering with the wound, but if it is not satisfactory an œsophageal tube should be used as recommended in tongue cases (see p. 100). Should a sinus in the neck persist, the finger may be placed over it when the patient swallows.

When the epiglottis and base of the tongue are removed, it may be some days before the patient can swallow at all, and three or four weeks before deglutition can be comfortably performed. In some epiglottic operations, the rapidity with which the power of swallowing is regained may be expedited by stitching back the tongue to the mucous membrane over the lower part of the epiglottis.

Palliative treatment.—If an operation is not possible or is not performed for some other reason, there is very little to be done for these patients. Both X-rays and radium have been shown to be valueless ; indeed with radium the growth is apt to spread more rapidly. Thyroid extract is equally inefficacious.

CHAPTER XII.

THE SURGICAL AFFECTIONS OF THE ŒSOPHAGUS.

In a person of average height the œsophagus is about nine inches in length and extends almost vertically from the lower border of the cricoid to the level of the ensiform cartilage; the landmarks behind are from the fifth cervical to the ninth dorsal vertebra. In front of the upper part of the œsophagus is the trachea; lower down are the left bronchus, the arch of the aorta, the pericardium, and the left vagus. Behind, it rests mainly upon the vertebral column and the thoracic duct, but about three inches above the diaphragm it crosses the aorta. The pleura lies on each side of the œsophagus, and the right pleura sends a prolongation behind it above, so that it is not easy to reach it on the right side in that situation without damaging the pleura. Above the arch of the aorta the œsophagus is best reached from the left side; below the arch, from the right side.

The total distance from the upper incisor teeth to the stomach averages 16 inches. The distance from the upper incisor teeth to the commencement of the œsophagus, *i.e.* the lower border of the cricoid cartilage, is about 6½ inches, to the bifurcation of the trachea about 11 inches, and to the point at which the aorta crosses the œsophagus about 12 inches. These measurements are very variable.

MALFORMATIONS.

A number of congenital malformations may be met with for which practically nothing can be done, and which need no description here; for example, communications between the trachea and the œsophagus, congenital constrictions of the œsophagus, and imperforate gullet.

ŒSOPHAGEAL DIVERTICULA.

This condition is similar to that met with in the pharynx (see p. 119), and most of the pouches of supposed œsophageal origin are situated at the upper part of the tube and probably originate from the pharynx.

What has been said with regard to the symptoms, diagnosis, and treatment of pharyngeal pouches applies also to these diverticula.

WOUNDS OF THE ŒSOPHAGUS.

These may be produced by violence from within or from without; the latter are the result of stabs, bullet wounds and the like. The most common injuries are those which occur from within, such as the unskilful employment of bougies, swallowing sharp-pointed or angular bodies, such as needles, tooth-plates or forks; rupture of the œsophagus sometimes occurs during very violent vomiting.

TREATMENT.—If the wound is not immediately fatal from injury to important structures in the neighbourhood, such as the large blood-vessels, it is invariably followed by suppuration in the cellular tissue of the neck and mediastinum, and this in its turn may lead to general septic disease. The obvious treatment is to open up the tissues in the vicinity of the injury sufficiently to provide effectual drainage, and at the same time if possible, to close the opening into the œsophagus. This may be done without any great difficulty as far as the portion of the œsophagus which lies in the neck is concerned, but as regards the intrathoracic portion, a much more severe procedure is necessary (see p. 169).

BURNS.

Burns from swallowing *boiling water* rarely occur in the œsophagus, as the water seldom reaches farther down than the lower end of the pharynx owing to the muscular contraction. Burns from *caustic fluids* are most important, because, if not immediately fatal, they give rise to serious trouble afterwards. When a caustic fluid is swallowed, the chief effect is produced on the more constricted portions of the canal, and the escharotic effect is most marked at the junction of the œsophagus with the pharynx, and in the neighbourhood of the cardiac end. The sloughs which follow the action of the caustic may be superficial or deep, and after they have separated ulcers of varying depth are left, which heal slowly and are followed by severe and irregular contraction of the lumen of the œsophagus. The stricture thus formed is often extensive and its satisfactory treatment is very difficult. The *symptoms* of these injuries are usually unmistakable. There is a history of swallowing boiling fluid or a caustic, followed immediately by intense pain, excessive thirst, and frequently hæmatemesis; considerable dyspnœa is often present. Death may occur very early from acute gastritis; if the patient does not die, the painful symptoms subside after a time and the separation of the sloughs is usually accompanied by much dysphagia. Sometimes the whole thickness of the wall of the œsophagus may be destroyed and a communication formed with the cellular tissue outside, leading to diffuse cellulitis or a peri-œsophageal abscess.

TREATMENT.—There are three main indications in treatment. The chemical agent causing the mischief must be neutralised as soon

as possible; then, rapid healing of the ulceration of the œsophagus must be favoured; finally, the constriction which is certain to occur subsequently must be prevented or diminished.

Neutralisation of the caustic.—If a mineral acid has been swallowed, powdered chalk or a solution of bicarbonate of soda should be administered, while vinegar and water should be freely given in the case of a caustic alkali. In carbolic acid poisoning, olive oil in large quantities is the best remedy.

Treatment of the subsequent ulceration.—The first essential is to insure rest to the œsophagus—partly to prevent the inflammation spreading through the œsophageal wall, and partly to promote cicatrisation. Hence *rectal feeding* (see p. 257) should be employed for as long as possible. The time will, of course, come when the patient must be fed by the mouth, but as long as his strength is fairly well maintained, this should be delayed: water may, however, be permitted in small quantities at a time. When the time comes for feeding by the mouth, it is well to begin with milk; as healing progresses, swallowing becomes less painful and feeding by the mouth may be increased, solid or semi-solid materials being employed.

The *pain*, which is always very marked on account of the constant swallowing of the saliva, is best relieved by the administration of *morphine* (gr. $\frac{1}{2}$ in an ounce of glycerine and water); a few drops placed on the back of the tongue and allowed to trickle down the gullet has a good local effect. An emulsion containing bismuth carbonate (gr. xv) and orthoform (gr. j or ij) to the ounce is useful in alleviating the pain; anodyne lozenges may also be sucked.

Prevention of contraction.—Contraction becomes evident in about three or four weeks after the separation of the sloughs, and from this time onwards efforts must be made to prevent it by passing bougies (see p. 173). The best form of bougie for the purpose is the conical black one which easily passes along the canal, while the gradual thickening of the instrument from the point upwards distends the œsophagus very gradually. The bougie is softened before being passed by placing it in hot water and is then well lubricated with butter. When there is much spasm, the pharynx should be anæsthetised with a 10 per cent. solution of cocaine. Several bougies in series should be at hand, and a good size to begin with is No. 14; the dilatation should not be held to be complete until a No. 24 has been introduced, but this size may not be reached until after several sittings. An interval of a week may be allowed to elapse between each sitting unless the contraction is considerable when the bougies should be passed twice a week. As soon as the contraction becomes stationary, the interval is gradually increased, but the treatment must be kept up for the remainder of the patient's life, otherwise contraction will recur.

The treatment of a simple stricture of the œsophagus after the ulceration has healed, is described on p. 173.

FOREIGN BODIES IN THE ŒSOPHAGUS.

Many varieties of foreign bodies may be found ; the most common are large boluses of food, fragments of bone, pins, needles, tin-tacks, coins, and tooth-plates. The *symptoms* to which the foreign body gives rise vary with its seat and its nature. Thus, large bodies generally become lodged at the commencement of the œsophagus and may cause not only much difficulty in swallowing, but also pressure upon the upper air-passages and a rapidly fatal dyspnœa. Needles, pins, or sharp fish-bones may penetrate the œsophageal wall and produce cellulitis or a peri-œsophageal abscess, or may even find their way into the large vessels, such as the arch of the aorta, and cause fatal hæmorrrage, either at once or after the lapse of some days. Needles may pass out of the œsophagus and migrate for considerable distances, often without causing any ill effects. Small objects, such as coins, usually pass further down the œsophagus and may cause no other symptoms than a certain amount of dysphagia, in the early stages, although they generally give rise to œsophageal ulceration if left alone. Ragged and irregular objects, such as tooth-plates (especially those with hooks), may become firmly impacted in the œsophagus, and the projections may ulcerate through the œsophageal wall, and lead to peri-œsophageal inflammation, or may ulcerate into the large vessels. This kind of foreign body is most dangerous because the projections become embedded in the œsophageal wall, and not only are a source of mischief in themselves, but often make the removal of the body by forceps passed down from the mouth a very hazardous proceeding. Foreign bodies are usually arrested at one of the narrow parts of the œsophagus—namely, the upper and lower extremities, and the point at which the aorta crosses it.

TREATMENT.—This will depend on the period after the accident at which the surgeon is called in, and varies with the seat of lodgment, the size, the shape, and the nature of the foreign body.

When the surgeon is called in immediately after the accident, the treatment must depend on the nature of the foreign body and the symptoms produced. In some cases the body may be only partly impacted in the upper part of the œsophagus and may project as a large mass into the lower portion of the pharynx, so that pressure upon the air passages and urgent dyspnœa may occur. These cases are dealt with on p. 123.

When a foreign body lodges in the upper part of the œsophagus, it may cause dyspnœa, but as a rule the symptoms are not sufficiently urgent to threaten life and there is plenty of time to locate the body and to decide how to deal with it. This is a point of importance, because the same treatment may not be advisable for smooth rounded bodies as for sharp pointed ones. Further, it is necessary to make sure that a foreign body is actually present in the œsophagus. It is not uncommon for a very nervous patient to vomit up the foreign body and still complain of all the symptoms of its presence.

Various measures may be taken to determine the presence and exact situation of the foreign body. When it is opaque to the X-rays, these are a ready and certain means of diagnosis. When, however, the body is not opaque to the rays, an olive-headed œsophageal sound (see Fig. 55) may be employed. This is passed down the œsophagus until the obstruction is reached, but no attempt should be made to dislodge the body by the instrument. When the body has been located, a small instrument should be passed and if possible insinuated beyond it, so that its size may be made out. The direct-vision œsophagoscope is a very valuable method of investigating the state of matters and should always be employed if it is available (see p. 163).

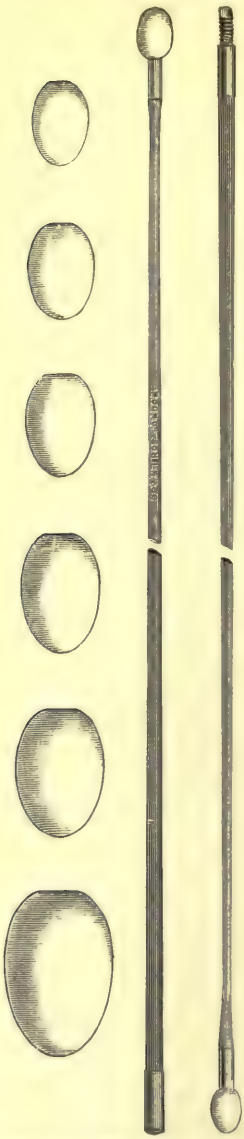

FIG. 55.—ŒSOPHAGEAL SOUNDS. This stem is made of whalebone and is flexible. The bulbous ends are made of aluminium and screw on and off the stem, so that one size is easily substituted for another.

After the position and nature of the foreign body have been ascertained an attempt should be made to remove it, either by making it traverse the œsophagus and enter the stomach or by withdrawing it through the mouth or through an opening in the neck. While care should be observed in the manipulation of any foreign body in this situation, special precautions must be taken if it has remained *in situ* for some time, because inflammatory softening of the œsophageal wall may have taken place, and consequently there will be a risk of damage to the œsophageal wall and other important structures during the attempts to remove it.

Propulsion of the foreign body into the stomach.—Boluses of food and smooth round bodies should be pushed down into the stomach, especially if they are situated at the lower part of the œsophagus. Small coins may also be similarly treated, if attempts to remove them with the aid of Killian's tubes and forceps, or to hook them up with a coin-catcher, fail. This is done by passing a full-sized sponge probang (see Fig. 56) down into contact with the foreign body and then slowly and steadily pushing it on into the stomach; if done gently and steadily, this may not cause pain. The most difficult

point is at the cardiac orifice of the stomach. A preliminary injection of morphine or a dose of chloral greatly diminishes the pain and spasm.

FIG. 56.—COIN-CATCHER AND PROBANG COMBINED. The lower portion is the sponge-probang, the upper the coin-catcher.

Although extremely useful for the cases we have just mentioned, the method should never be employed for bodies which markedly distend the œsophagus, such as large coins, or for objects which have sharp angles or hooks, as severe laceration of the œsophageal wall is apt to result, and a foreign body previously impacted in some accessible region may become fixed in the œsophagus low down and out of reach of safe operative interference.

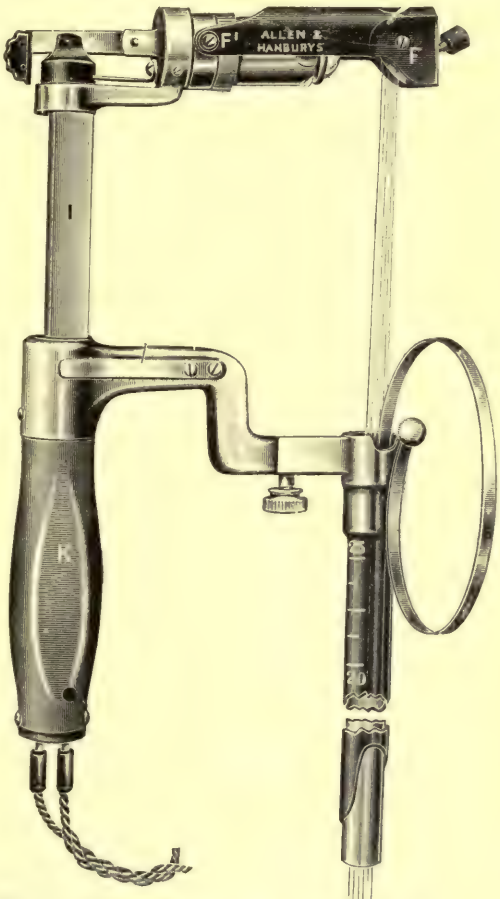

FIG. 57. — ŒSOPHAGOSCOPE WITH BRÜNING'S LAMP. The various portions of the œsophagoscope are shown in more detail in the following figure. The sketch above shows the arrangement of the handle and the lamp. The latter is focussed by sliding the arm (I) in the handle (K). The light is reflected down the tube from a mirror in the hood (F). This hood is on a pivot at F' so that it can be swung back to enable instruments to be passed down the tube.

Extraction through the mouth.—When the foreign body is small (such as a fish-bone, a needle, a coin, a tin-tack, or a portion of bone), attempts must be made to extract it through the mouth. This can be done by means of the œsophagoscope (see Fig. 57), which enables the surgeon to see the foreign body and seize it with suitable forceps.

The œsophagoscope and the method of using it.—The œsophagoscope consists of an outer tube or spatula into which an inner tube fits. The tubes are made of

different lengths and diameters, so as to suit patients of various ages, and they are provided with a conical obturator which serves as an introducer. By means of a watch-spring attached to the upper end, the inner tube can be protruded for a variable distance through the outer. Both tubes are graduated in centimetres so that the exact distance of the instrument from the teeth can be read off. A handle is fixed to the outer tube for the attachment of a Brüning's hand-lamp, which is constructed so as to throw a beam of parallel rays down the tube and thus give a maximum of illumination. The lamp can be moved to the right and left, or raised so as to avoid interference with the passage of instruments down the tube.

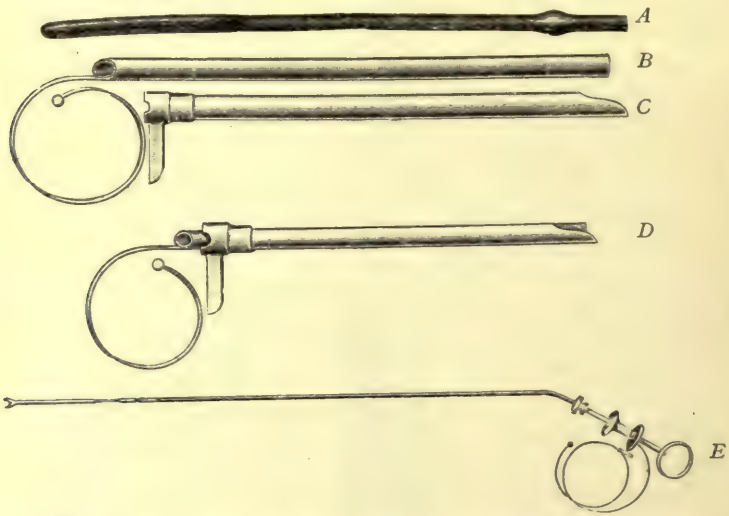

FIG. 58.—ŒSOPHAGOSCOPE TUBES AND FORCEPS. The tube, *C*, which is made in varying sizes, is inserted with the obturator, *A*, inside it. *B* is the inner tube which is inserted after removal of the obturator, as shown in *D*; it can be projected a considerable distance beyond the end of the tube, *C*, by means of the watch-spring attached to its upper end. *E* is a pair of œsophageal forceps for removal of foreign bodies.

Special forceps which can be lengthened and which are provided with detachable jaws for the removal of different kinds of foreign bodies are necessary (see Fig. 58).

Dr. William Hill has introduced an elliptical instrument of much larger diameter with a slit extending the whole length of one side of the tube; the tube tapers from the proximal to the distal end. The increased calibre of the tube enables larger forceps to be used, and the lateral slit allows a tube containing radium to be more readily introduced into a cancerous stricture.

In children a general anæsthetic is necessary. In adults, local anæsthesia produced by the application of a 10 per cent. solution of cocaine to the pharynx, the aperture of the larynx, and the region behind

the cricoid, will suffice for a short examination ; for a longer examination a general anæsthetic is required. Chloroform is preferable to ether, as it causes less secretion of mucus. During the whole examination, a careful watch should be kept on the general condition of the patient ; stimulants, oxygen, and tracheotomy instruments should be at hand in case they are required.

Position of the patient.—For short examinations, the patient may be seated if local anæsthesia is being employed ; under other conditions the recumbent position is essential, the head being turned to the right and extended, or supported in the extended position beyond the end of the table. The former position of the head is preferable, as the mucus and saliva then escape more easily from the angle of the mouth and the introduction of the instrument is more readily accomplished. The head must not be over-extended, for this makes the passage of the instrument much more difficult.

Method of introduction.—The instrument is sterilised, warmed, and lubricated with liquid paraffin or glycerine. The mouth is opened as widely as possible and the instrument passed from one side, usually the right, to the base of the tongue, which is pressed forward partly by the instrument and partly by the left forefinger. The tube is passed over the epiglottis into the upper end of the œsophagus by keeping it in contact with the wall of the pharynx. As it enters the œsophagus the end of the instrument is depressed, and at this stage it may be necessary to rotate it. The inner extension tube is then placed in position and pushed on as far as is necessary. Before inserting the extension tube, the Brüning's lamp should be attached to the handle and an examination made so that any stricture or foreign body may be seen, and the extension tube is then passed with the aid of direct vision. Force must never be employed and it must be remembered that in diseased conditions and in inflammatory affections following the long-continued presence of a foreign body, the œsophageal walls may be thinned, and perforation by the instrument may occur unless it is very carefully manipulated. Indeed, several fatalities have been recorded from these causes, and special care should be taken to exclude the presence of a thoracic aneurysm.

Indications for use.—The œsophagoscope may be employed to localise and remove foreign bodies, to determine the presence and nature of a stricture, and to facilitate the introduction of bougies or œsophageal tubes or radium into a stricture. When search is being made for a foreign body, the instrument may pass it unless visual inspection is made both during the introduction and the withdrawal of the tube ; the foreign body may sometimes be hidden by the swollen mucous membrane or buried in thick mucus. Different kinds of forceps should be at hand as well as hooks and probes of various sizes. The body may be too large to extract through the tube after it has been seized by the forceps, and in that case the tube-forceps, and foreign body may be withdrawn together after the latter has

been securely seized. It may even be necessary to break up the foreign body, *e.g.*, a tooth-plate, before it can be extracted.

When an œsophagoscope is not available other methods must be employed. When high up in the œsophagus or partly in the œsophagus and partly in the pharynx, attempts may be made to remove the body with forceps (see Fig. 59). In the case of small, smooth bodies the administration of an emetic, such as a subcutaneous injection of apomorphine hydrochloride (gr. $\frac{1}{6}$) may lead to the expulsion of the foreign body, but this method should not be employed unless the foreign body is quite

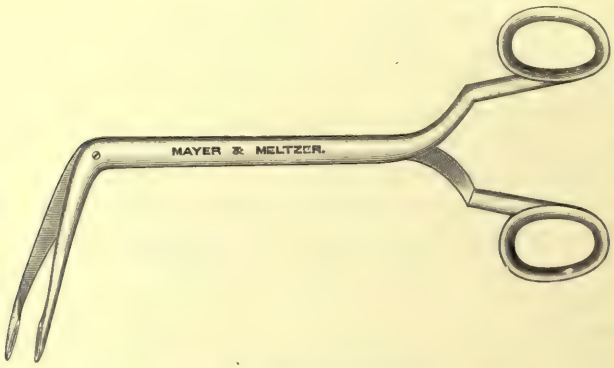

Fig. 59.—Œsophageal Forceps.

Fig. 60.—Expanding or 'Umbrella' Probang. At the tip is a piece of sponge. The horse-hair 'brush' is made to expand (see dotted line) by pulling upon the whale-bone end.

small and free of projections. The same remark applies to the inversion of young children.

When the foreign body is sharp and pointed and not opaque to the X-rays, such as a fish-bone, the umbrella or sweep's-brush probang of Fergusson (see Fig. 60) is useful. The instrument is passed closed beyond the supposed situation of the foreign body in the same manner as the ordinary probang. It is well to pass it to its full length, so that its lower end reaches the cardiac orifice of the stomach. By traction upon the whale-bone end, the sweep's brush is then made to project and the expanded instrument is withdrawn. The bristles catch and dislodge the foreign body, which becomes entangled in them and is withdrawn through the mouth. Extreme gentleness is essential.

When the body is metallic and opaque to the X-rays, it may be comparatively easy to pass forceps down the œsophagus, and, guided by the fluorescent screen, to grasp and remove it.

Removal of coins.—Coins frequently lodge edgeways in the œsophagus (see Fig. 61) and can then be removed by the instrument known as the coin-catcher (see Fig. 56). This instrument, properly lubricated, is passed along the œsophagus until its metal end strikes the coin. The metal head of the coin-catcher is then insinuated past the coin, taking care not to dislodge the latter, and, when well below it, the instrument is drawn up; the coin catches in the head of the instrument (see Fig. 61), and may be brought up into the mouth. There is little fear of the coin slipping out of the instrument if it is withdrawn quite slowly, as the œsophageal walls grasp it and keep it in position. Should the coin slip out of the coin-catcher at the upper part of the œsophagus and the X-ray screen be available, extraction with forceps may be attempted.

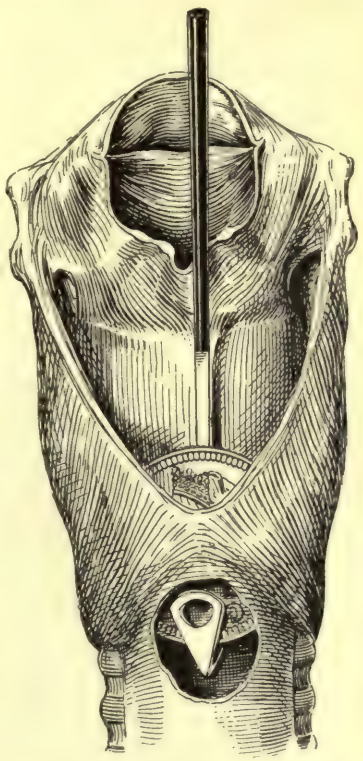

Fig. 61.—Removal of a Coin from the Œsophagus. The figure shows how the coin, lodging vertically in the œsophagus, is caught in the coin-catcher and brought up, still embraced firmly by the œsophageal walls.

Extraction through an external incision. — When a large, jagged, irregular body, such as a tooth-plate, is impacted in the œsophagus, any attempt either to push the body into the stomach or to remove it through the mouth is likely to fail because of the projections; moreover, severe laceration of the œsophageal walls may occur during the procedure. Hence when an œsophagoscope is not at hand or when attempts at removal through it fail, the question of an external operation must be considered. There are three methods of removing the foreign body by operation. Most usually an incision is made in the neck so as to reach the upper part of the œsophagus, and the foreign body is drawn up through it. When, however, the impaction occurs low down, it may be advisable to open the stomach and try to extract the foreign body from below. In some cases it has been proposed to open the œsophagus in its course through the posterior mediastinum and extract the body by direct incision through the wall of the chest.

Cervical œsophagotomy.—When the foreign body is situated above the level of the clavicle, its extraction by œsophagotomy is comparatively easy. The first point is to localise the body exactly, which is done either by a radiogram (if the body is opaque to the X-rays), or else by careful exploration with an œsophagoscope or an œsophageal sound. The œsophagus is then exposed through an incision along the anterior border of the left sterno-mastoid in an exactly similar manner to that given on p. 120 in connection with the operation for removal of pharyngeal pouches.

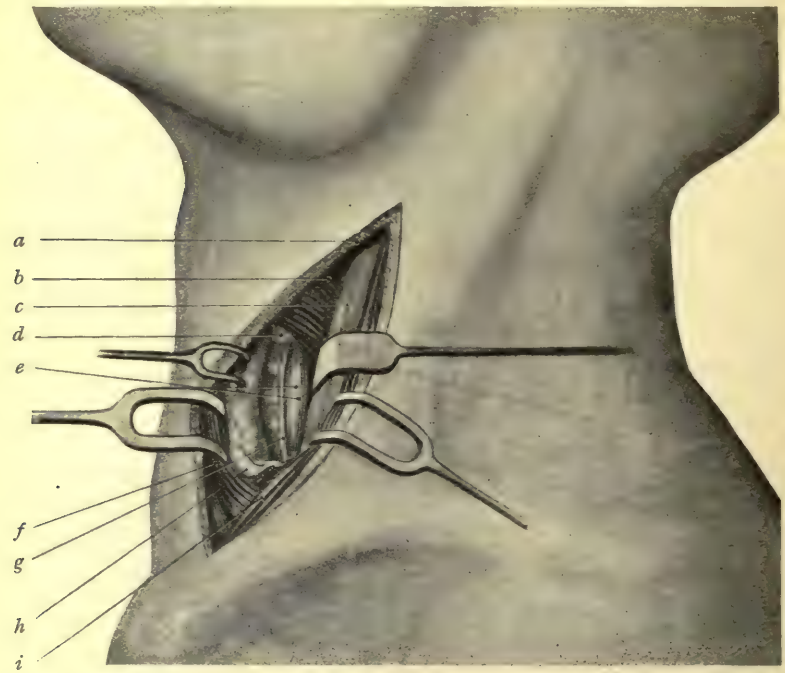

FIG. 62.—ŒSOPHAGOTOMY. *Exposure of the Œsophagus in the Neck.* *a*, Platysma; *b*, inferior constrictor; *c*, carotid sheath; *d*, cricoid cartilage; *e*, œsophagus; *f*, depressor muscles of the hyoid bone; *g*, recurrent laryngeal nerve; *h*, thyroid gland and inferior thyroid artery; *i*, sterno-mastoid muscle.

When the œsophageal wall has been exposed, the recurrent laryngeal nerve, if visible, should be hooked forwards into the angle between the trachea and the œsophagus. The foreign body, if high up, may then be felt through the œsophageal wall, or, if not, an olive-headed sound should be passed down to it and a sufficiently free vertical incision is made directly over the tip of the sound. A smooth rounded body does not need a large opening, but an irregular body, such as a tooth-plate, requires an incision practically equal in length to its long axis. The edges of the incision are held apart by catch forceps, and the foreign body carefully extracted, any projecting arms or hooks being unhitched from the mucous membrane.

or if necessary cut off by cutting pliers and removed separately ; it is far better to cut up a body into small pieces and remove it in fragments than to cause any laceration by tugging at it during removal.

The incision in the œsophageal wall should be closed as after pharyngotomy (see p. 121), and the after-treatment is similar to that described on p. 121. Free drainage should be provided, as leakage is apt to occur through the œsophageal wound ; indeed, when the foreign body has been in position for some time, the best plan is to leave the incision in the neck open and stuff it lightly with iodoformed gauze. This is particularly important when the wound is low down in the neck ; when it is higher up, it may be sufficient to insert a large drainage tube down to the neighbourhood of the incision in the œsophagus and to close the rest of the wound by sutures. Healing by granulation occurs readily enough, even when primary union in the œsophagus fails, and a permanent fistula is not likely to follow.

When the foreign body is impacted below the level of the clavicle, the case is much more serious ; unless the body is removed, death will in many cases take place before long, either from ulceration into the large vessels, which usually occurs within the first fortnight, or from ulceration into the mediastinum followed by fatal mediastinitis. Hence every effort must be made to remove the foreign body, and even if the first attempt fails, important information may be gained as to the value of other methods, and the employment of the œsophagoscope or the fluorescent screen (if the body is opaque to the X-rays) is often of very great assistance. When the foreign body is impacted near the upper end of the thoracic part of the œsophagus it may still be reached by an opening as low down in the neck as possible.

Gastrotomy.—When the foreign body is impacted quite close to the cardiac end of the œsophagus it may sometimes be removed by making an incision into the anterior wall of the stomach that will admit the hand, dilating the cardiac orifice and extracting the foreign body either directly with the fingers or with suitable instruments passed up from below. The steps of the operation of gastrotomy are described in Chap. XVI.

Mediastinal œsophagotomy.—The most important and difficult cases are those in which the foreign body is impacted in the thoracic portion of the œsophagus in such a position that it cannot be reached either from an opening in the neck or from the stomach. It may be said at once, however, that the lower part of the œsophagus, immediately in front of the aorta, is inaccessible to the surgeon, and the œsophagus can only be reached in the upper and middle part of the thorax. The best operation for exposing the thoracic portion of the œsophagus is that suggested by Dr. J. D. Bryant [1] for gaining access to the mediastinum, either with the view of exposing the œsophagus, evacuating pus, or removing mediastinal tumours. The patient should be anæsthetised by the intratracheal

[1] See *Operative Surgery*, by Joseph D. Bryant, M.D., vol. ii. p. 1046 (Kimpton, London 1901), to which the reader is referred for full details of the operation.

method and turned over on his face and a flap raised towards the middle line on the left side of the spine. Portions of three ribs are resected without damaging the parietal pleura, which is pushed aside with the finger. The foreign body may then be felt and an incision for its extraction made over it ; if it cannot be felt, the œsophagus may be opened on a bougie and the body reached by forceps or the finger.

The great danger of the operation is the risk of fatal mediastinal suppuration. It is almost impossible to suture the œsophagus accurately, and, in addition, the wound becomes contaminated when it is opened ; at the same time, however, it must not be forgotten that a foreign body impacted in this situation will ultimately cause a fatal result, and it is almost imperative to give the patient the chance that this operation offers.

INFLAMMATORY AFFECTIONS.

We distinguish between an œsophagitis and a peri-œsophagitis, according as the inflammation is actually in the œsophageal wall or in the tissues around.

Acute œsophagitis is very rare except as a complication of injury, such as may be produced by foreign bodies or by swallowing caustics. The œsophagus may become acutely inflamed in septic conditions of the mouth, thrush, diphtheria, and the like, but the condition is one of great rarity.

Chronic œsophagitis.—This may follow upon an acute inflammation ; it is common in the portion of the œsophagus above a stricture and may then considerably increase the dysphagia and the pain.

Peri-œsophagitis or inflammation of the cellular tissues around the gullet may occur from perforations of the œsophageal wall or may spread from inflammatory foci in the neighbouring tissues such as the glands or the spine.

TREATMENT.—This will consist in incising any large inflammatory swelling or evacuating any abscess that has formed. Tracheotomy may be required in bad cases.

TUBERCULOSIS.

This is a very rare affection in the œsophagus, and only a few cases are on record. The condition gives rise to very indefinite symptoms, dysphagia being the most marked ; as a rule the cases are mistaken for cancer. Little can be done in the way of local treatment ; general treatment must be carried out on the lines laid down in Vol. I.

SYPHILIS.

This is also a rare condition, but tertiary ulceration of the mucous membrane or gummata in the œsophageal wall may be met with. The chief symptom is dysphagia; the diagnosis is difficult and is practically only made because of a previous history of syphilis, by the presence of a positive Wassermann reaction, and by finding that improvement occurs under antisyphilitic treatment and that there is no characteristic sign of cancer. It must, however, be remembered that in the majority of cases the patient is old and worn out, and the syphilitic affection may be the forerunner of a cancerous one.

The treatment should be the general treatment of syphilis (see Vol. I. Chap. XI.), combined with the routine passage of bougies (see p. 173) to avoid any constriction.

STRICTURE.

Difficulty in swallowing may be due to causes external to the gullet, such as pressure from new growths in the mediastinum or the neck, from tumours originating in the vertebræ, or from an aneurysm of the large vessels. It may also be caused by changes in the œsophageal walls, the result of inflammatory conditions or new growths, or it may follow blocking of the tube by foreign bodies in the interior. Finally, it may be a purely nervous affection, due either to paralysis, or, much more frequently, to spasm of the œsophageal muscle.

All these causes must be borne in mind by the surgeon who investigates a case of difficulty in swallowing. The most important of all is the possibility of the affection being due to the pressure of a thoracic aneurysm, and therefore in every case the surgeon must examine the chest and satisfy himself that no aneurysm is present before any attempt at treatment or diagnosis by passing an instrument is undertaken. Neglect of this precaution has led to the most lamentable accidents, as a bougie passed down the œsophagus, even with great gentleness, may readily find its way into the sac of an aneurysm which has so thinned and softened the œsophageal wall by pressure that the slightest touch will perforate it.

As a large aneurysm may exist without its presence being revealed by the ordinary methods of percussion and auscultation, an X-ray examination should be made before instruments are passed.

SIMPLE CICATRICIAL STRICTURE.

This is usually the result of some ulceration of the mucous membrane such as that produced by caustics, by the long-continued impaction of foreign bodies in the œsophagus, or by syphilitic or tuberculous disease.

The most common cause is the ulceration due to swallowing a caustic fluid, and the ulceration occurs irregularly over the mucous membrane, is most marked at the upper and lower ends of the œsophagus, and varies considerably in depth and extent. This leaves an irregular fibrous stricture, in which considerable tracts of healthy mucous membrane are divided from one another by cicatricial bands. The obstruction to the passage of food commences early, is very marked, and increases rapidly. The irregularity in the distribution of the cicatricial tissue also tends to make the treatment of the affection by the passage of bougies a matter of extreme difficulty.

Diagnosis and localisation of the stricture.—Before commencing treatment, an exact diagnosis should be made and the precise limits of the obstruction should be ascertained. After the presence of an aneurysm has been excluded, the œsophagus is explored with an olive-headed bougie (see Fig. 55), which consists of a metal bulb attached to a flexible whalebone shaft. The metal bulbs are of different sizes and are made to screw on and off. A full-sized bulb (No. 24) should be used in order to detect whether there is a stricture or not, and also the exact distance of its upper end from the teeth. This is important, because a small instrument may pass through a comparatively insignificant stricture and may not be arrested until it reaches one of smaller calibre lower down. When the first sound is arrested, the measurement to the upper incisor teeth is taken and a smaller bulb substituted. Should this fail to pass the obstruction, a smaller size still is employed, until one is found that passes through the stricture into the stomach. When this has happened, the sound is slowly and cautiously withdrawn, until the upper edge of the metal bulb catches against the lower edge of the stricture, and then the distance of this point from the upper incisor teeth can be ascertained. By these means the situation of both the upper and lower extremities of the stricture and the length of the obstruction can be determined. It is usual to have the shaft of the bougie graduated so as to get an exact measurement.

Valuable information as to the position, length, and calibre of the stricture may also be obtained by means of the X-ray fluorescent screen. The patient stands with the screen in front of his thorax. A cachet of bismuth is given, and its passage down the œsophagus is observed on the screen. When it reaches the upper limit of the stricture, the cachet will be arrested. Another method is to cause the patient to swallow a thick emulsion of bismuth oxychloride. As the emulsion passes down, it adheres to the œsophageal walls, and will show on the screen and in a radiogram a broad or narrow streak, according to the size of the lumen of the œsophagus. The situation and character of the upper end of the stricture can also be well demonstrated by means of the œsophagoscope, and the presence of ulceration, or malignant disease can be ascertained in this way.

TREATMENT.—In all cases of cicatricial stricture of the œsophagus, the treatment is both medical and surgical.

(*a*) **Medical.**—The medical treatment should provide for the nutrition of the patient and also allay the pain and spasm in swallowing, which are frequently present, especially when there is ulceration above the stricture; the difficulty in swallowing produced by the mechanical obstruction is much increased by spasm of the muscular coat. The diet should be concentrated and nourishing, and should be either entirely fluid or at most semi-solid and free from masses which might become arrested and block the lumen. If there is much difficulty in taking sufficient food by the mouth, and if the patient cannot bear a permanent tube, rectal feeding (see p. 257) should be resorted to as well, especially if the case is in the early stage and if the difficulty arises more from spasm due to the inflammatory condition than from actual narrowing of the œsophagus. If, however, the latter is so extreme that the patient runs the risk of actual starvation, no time should be wasted in feeding by the rectum, but surgical measures, such as œsophagostomy if the stricture is high up (see p. 168), or gastrostomy if it is too low down, should be adopted. The intense thirst from which many of these patients suffer should be met by rectal injections of normal saline solution. The best sedatives are opium and belladonna in small quantities, which may be given mixed with a little glycerine or in an emulsion, so as to make a dose small in quantity and sufficiently tenacious to cling to the œsophagus as it is swallowed; this should be given a short time before food.

(*b*) **Surgical.**—This has two main objects. In the first place it aims at dilating the stricture and maintaining this dilatation, and nothing further is required when the contraction is not too great to prevent bougies being passed, and when the patient can swallow sufficient food to maintain his strength. In the second place, when the patient has an extremely tight stricture which will require some time for its dilatation, and is at the same time unable to swallow, the first object is to feed him, and for this purpose it may be necessary to perform gastrostomy at once.

Dilatation of the stricture.—This may be done in a variety of ways, but as a rule the best results are obtained by simple dilatation with graduated bougies.

Intermittent dilatation.—This consists in passing a bougie of suitable size through the stricture, retaining it in position for a few minutes, and, if deemed advisable, passing a larger one immediately afterwards. After allowing an interval of three days at least to elapse, so that the irritation caused by the instrumentation may subside, further dilatation is carried out. Unless the stricture is very obstinate, this method will dilate it in the course of time, and the interval between the passage of the bougies may be gradually increased. The use of bougies can, however, never

be discontinued, and the patient must either pass them himself or have them passed for him at intervals for the rest of his life.

The best bougie for the purpose of intermittent dilatation is probably the silk-web form, which is quite safe and with which it is practically impossible to do any damage. The more solid forms are somewhat more dangerous, especially when there is any ulceration. It is important not to use too small an instrument at the first sitting; the best plan is to try one of full size (No. 24) and to work downwards until a size is found that will pass the stricture. The bougie should be softened by immersing it in boiling water and the instrument should then be lubricated with butter or glycerine; the former is preferable, as some patients object to the sweet taste of the glycerine. The pharynx and the laryngeal aperture may be painted with a 10 per cent. solution of cocaine in order to lessen the spasm as the bougie passes over the glottis. The patient sits facing the surgeon in a chair with a high back or against the wall, the head being so supported that it cannot be drawn back, The hard palate should be horizontal and the mouth wide open. The instrument is passed well back into the pharynx without touching the dorsum of the tongue and pressed against the posterior pharyngeal wall, when the softened tip bends easily and the instrument find its way down the pharynx. If preferred, a slight downward bend may be imparted to the tip of the instrument before it is passed, and this is advisable in the case of the larger instruments, so as to avoid undue pressure on the posterior pharyngeal wall; with the smaller sizes it is unnecessary. As the bougie passes the region of the glottis there is usually considerable spasm, the patient coughing and choking, but this only lasts for a few seconds and is greatly diminished by instructing the patient to bend the head well forward so that the saliva runs out of the mouth, and to take a few deep inspirations; this rapidly checks the spasm, and when the point of the bougie has passed beyond the laryngeal aperture the spasm soon ceases. The instrument should be passed down the œsophagus slowly and steadily without using any force, otherwise spasm is easily set up and greatly embarrasses the procedure. The application of cocaine to the fauces and posterior pharyngeal wall usually abolishes the spasm entirely.

When the stricture is reached, careful attempts are made to insinuate the bougie through it, much in the same way as in the case of a urethral stricture; if force is used, the point of the instrument may either penetrate the œsophageal wall or may curl upon itself and return through the mouth. It can generally be ascertained whether the bougie has found its way into the stricture by feeling that its point is grasped, that is to say, it cannot be pulled out readily. When this is the case and the instrument cannot be passed on through the stricture without using undue force, the best plan is to leave the bougie in position for five minutes, the patient in the meantime bending the head well forwards over a basin to allow the saliva to escape; the bougie is then withdrawn. No attempt should

be made to pass it on into the stomach if it is grasped tightly, because it is quite possible that there may be several strictures along the course of the œsophagus, and an instrument grasped tightly by the upper one can no longer be controlled and may do serious damage if force is employed. The proper plan is to dilate the upper stricture first and then to attack those lower down. If there is difficulty in passing a bougie into the orifice of the stricture, advantage may be obtained by the use of the œsophagoscope, which enables a view of the orifice to be obtained.

After an interval of three days, a further attempt should be made in a similar manner, when it will probably be found that the bougie previously employed, will pass easily through the upper stricture. As soon as the stricture is fairly easily passed, it is well to substitute the black conical bougies for the softer instruments, so that a little more force may be exerted and the stricture may be more rapidly dilated. Little harm can be done with these instruments as soon as a stricture is dilated sufficiently for their points to pass through ; the fine bulbous end acts as a guide for the rest of the dilating bougie. The number of bougies used at one sitting must vary with the progress made. It is often sufficient to pass one or two sizes and to begin the next sitting with the largest size employed on the previous occasion. It is certainly not advisable to push the dilatation of a stricture of the œsophagus as rapidly as in the case of strictures of the urethra.

The passage of bougies at these frequent intervals should be maintained until the stricture is fully dilated, and not until then should a longer interval elapse between the sittings. As soon as full dilatation has been reached, an interval of a week may be allowed and, if the patency of the canal is maintained sufficiently by the passage of a bougie once a week for two or three months, the interval may be lengthened to a fortnight, and after another two or three months, if matters are satisfactory, the passage of instruments once a month will probably be sufficient to keep the stricture effectually dilated. In no case, however, must the patient go for longer than a month at a time without having an instrument passed, and, if at any time there is any sign of recurrence of the contraction, the intervals must be made shorter. If the patient complains of the trouble to which this exposes him, it should be pointed out that, while the maintenance of dilatation in a fully dilated stricture is a comparatively simple and painless process, the dilatation of a tight one is quite another matter.

Continuous dilatation.—The method of intermittent dilatation suffices in the great majority of cases, but some are occasionally met with in which the contraction is so great and the scar tissue so dense that it does not yield readily to the intermittent passage of bougies—a condition similar to that which occurs in the urethra. For strictures of this kind some form of continuous dilatation, such as that employed for the

urethra, may be tried. A long œsophageal tube (see Fig. 63) large enough to fill the stricture is passed through it and left in position, the end emerging from the mouth and being fastened to the cheek with strapping or with silk round the ear. The patient is confined to bed and the head should be turned over to one side so as to allow the saliva which collects above the stricture to escape freely. Feeding is carried out by means of the tube, carefully filtered milk and beef-tea being introduced into the stomach as required. This tube is left in position for twenty-four to forty-eight hours, when it will be found that, whereas at first it was tightly grasped by the stricture, it has now become loosened, and, when it is withdrawn, a tube two or three sizes larger may be passed, tied in and left as before, a larger one being then substituted for it in turn, and so on until full dilatation is reached. The great trouble is to persuade the patient to submit to the treatment as it is most irksome. The annoyance may, to a great extent, be mitigated by substituting a Symonds's short tube (see Fig. 64) for the long one as soon as a moderate degree of dilatation (such as may be reached in about a week) has been accomplished. This allows the patient to swallow saliva and food and to taste the latter, and with a little practice it can be passed easily after some preliminary dilatation with the longer tubes has been carried out. Symonds's tubes are, however, only suitable for cases in which the stricture is situated well below the cricoid cartilage, otherwise the funnel-shaped end presses upon the larynx and causes considerable laryngeal irritation. These tubes are referred to in detail in connection with cancer of the œsophagus (see p. 181).

Fig. 63.—Long Œsophageal Tube.

In order to diminish the salivation, tincture of belladonna or liquor atropinæ sulphatis (B.P.) may be given.

Operative procedures.—When these methods fail, the question of operative measures must be considered. It will suffice if we indicate shortly the various operative procedures that can be employed.

Forcible dilatation by instruments passed down the canal has been suggested, but there is great risk of rupture of the wall of the œsophagus

and suppuration in the cellular tissue outside. *Internal œsophagotomy* (similar to internal urethrotomy) has been employed, but is only applicable to strictures at the upper end and is accompanied by a great risk of septic cellulitis.

The aim of the remaining operations is to make an opening as close to the stricture as possible so as to pass a bougie through it and carry out gradual dilatation, or to divide the stricture with a tenotome; the introduction of the œsophagoscope has rendered these procedures unnecessary in most cases. The opening may be made either above or below the stricture and a bougie or bougies introduced through it; if this can be done, the upper end of the bougie is brought out through the mouth and left *in situ* and continuous dilatation (see p. 175) carried out. The opening in the œsophagus is closed immediately. In other cases there is a tight stricture at the lower end of the canal which cannot be reached from the neck. In these a good deal can sometimes be done by opening the stomach and attacking the stricture from below.

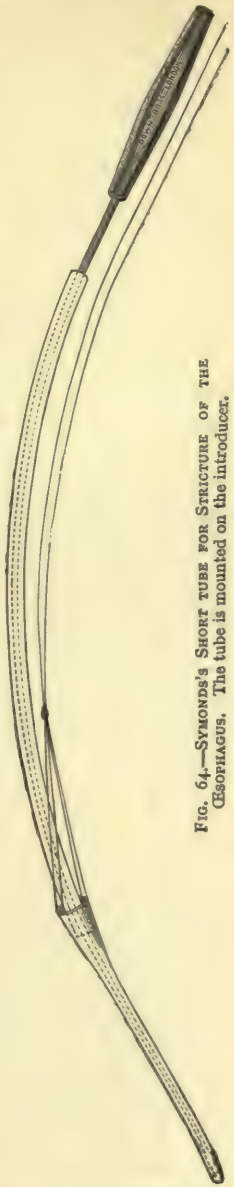

FIG. 64.—SYMONDS'S SHORT TUBE FOR STRICTURE OF THE ŒSOPHAGUS. The tube is mounted on the introducer.

Gastrotomy.—The stomach is exposed in the usual manner (see p. 184) and drawn well out of the wound and packed off from the general peritoneal cavity so as to avoid infection. An opening is made on its anterior surface midway between the two curvatures as near the cardiac orifice as possible and large enough to admit two or three fingers. An attempt is then made to pass bougies upwards through the stricture. If this is successful, the stricture is dilated as far as possible, and a tube is passed through the stricture from the cardiac end of the stomach into the pharynx and made to emerge through the mouth and tied in. The case then becomes one of continuous dilatation; gradual dilatation is substituted later on. Abbe carries out the immediate dilatation of the stricture in these circumstances by attaching a thread to a bougie passed up into the mouth, and then seizing both ends of the thread and moving them backwards and forwards, and sawing through the greater part of the stricture. As a result a large bougie can be left in, and the subsequent treatment is easier. The

question of how to treat the wound in the stomach after a bougie has been successfully passed through the stricture is a matter of importance. Perhaps, on the whole, it is best to conclude by performing a gastrostomy such as Witzel's or Kader's (see p. 184), which will close spontaneously if the treatment of the stricture is successful, but which can be used permanently should it fail.

Gastrostomy.—When a patient suffering from extensive and impassable stricture is unable to take sufficient food to support life and is brought almost to the verge of starvation, gastrostomy is called for to avert impending death. Not only does this operation enable the patient to obtain nourishment, but also it is often found that the rest given to the œsophagus by the artificial opening into the stomach is followed by considerable improvement in the stricture, and not infrequently improvement in swallowing occurs in a few days.

This is probably due to diminution of congestion and spasm resulting from the rest. While gastrostomy is absolutely necessary to save the patient's life and to keep up his strength, it should only be looked upon as a temporary measure, and fresh attempts should be made after a week or two to dilate the stricture from the mouth (see p. 173). When once the stricture has been dilated, the gastrostomy opening may be allowed to close, or, if necessary, an operation may be performed for its closure. The operations of gastrostomy are described on p. 184; for the cases under consideration we recommend Witzel's or Kader's, which are not only efficient, but have the advantage that the fistula produced, is always ready to close when the tube is left out, so that, when sufficient dilatation of the stricture has been obtained, it is only necessary to discontinue passing the tube through the gastric fistula.

SPASMODIC STRICTURE.

Spasm of the œsophagus is an affection chiefly met with in women between the ages of twenty and thirty. It may occasionally occur in older subjects about the menopause. As a rule the trouble is neurotic and only part of the general condition. The diagnosis is of the greatest importance, as the surgeon must be very careful that no organic lesion is present. The age of the patient, her neurotic temperament, the absence of hæmorrhage or signs of ulceration, the varying tightness of the stricture under different conditions, and the fact that, at any rate under an anæsthetic, a full-sized bougie can be passed into the stomach without encountering any obstruction, and that solids are often swallowed more easily than fluids, are the principal points in the diagnosis.

TREATMENT.—This consists essentially in the employment of medical, hygienic, and dietetic measures suitable for neurotic subjects. Antispasmodic drugs like atropine, bromide of potassium, or valerian

may be administered, while occasionally the Weir-Mitchell treatment (see Vol. III. p. 138) is of value. The passage of a full-sized bougie once a week or once a fortnight is often distinctly beneficial.

BENIGN GROWTHS.

Tumours in connection with the œsophageal wall are a very important cause of dysphagia; they may be either simple or malignant, more frequently the latter.

The simple tumours may be *myomata, adenomata, lipomata,* or *cysts.* They are all comparatively rare, and when they attain any considerable size are frequently pedunculated, with a long and narrow pedicle, whilst the tumour itself is flattened—the so-called 'œsophageal polypus.' Many of these are really pharyngeal in origin, but sometimes they originate in the œsophagus.

The tumour may cause difficulty in swallowing, or, on the other hand, it may be small and only be discovered *post mortem.* When the pedicle of the polypus is long, the tumour may be projected up into the pharynx during vomiting, and may then be visible.

TREATMENT.—If a polypus of the œsophagus causes symptoms it must be removed, and the method by which this is done will vary according to its situation. When it is a pharyngeal polypus which is hanging down into the œsophagus, it may be possible to insinuate the loop of a snare around the pedicle and so to remove it. The loop may be passed round the pedicle in various ways and the use of the œsophagoscope will greatly facilitate this. If the attempt to snare the pedicle fails, it will be necessary to perform œsophagotomy (see p. 168), expose the pedicle, transfix and ligature it, and cut the tumour away.

MALIGNANT GROWTHS.

Carcinoma of the œsophagus is by far the commonest cause of stricture, and when difficulty in swallowing occurs in people who have attained middle age and in whom there is no history of having swallowed a caustic and no sign of external pressure, the diagnosis is almost certainly that of a cancerous stricture; the chief alternative is syphilitic disease, which is extremely uncommon in the œsophagus. The growth is practically always a squamous epithelioma, and the tumour usually occurs at the narrowest parts of the gullet—namely, at its commencement, its cardiac end, or opposite the bifurcation of the trachea. The most common seat is probably the first of these.

The growth commences in the œsophageal mucous membrane, giving rise to a tumour at one side of the gullet which may attain a considerable size before the entire circumference of the mucous membrane is affected. Ulceration occurs early and hæmorrhage is not uncommon.

The tumour infiltrates the muscular walls and affects the surrounding structures or the glands in the lower part of the neck or mediastinum comparatively early. When situated high up, it may ulcerate into the trachea and give rise to a fistulous communication between the œsophagus and the air-passages. Lower down it may attack the wall of the aorta and lead to fatal hæmorrhage. In other cases again it may spread by direct extension to the lungs, or communicate with the mediastinum and lead to septic mediastinitis. Various pressure symptoms may occur from implication of nerves in the neighbourhood.

After symptoms of stricture have become manifest, the life of the patient is comparatively short; death usually occurs in three or four months unless means are taken to feed the patient artificially; even after gastrostomy, the patient usually dies within a year from the commencement of the symptoms and generally earlier. The fatal result may be due to marasmus or to complications such as septic broncho-pneumonia from ulceration into the trachea, hæmorrhage, mediastinal suppuration, or tuberculosis; the latter disease seems to be common in cases of stricture of the œsophagus, whether simple or malignant.

The chief *symptom* is dysphagia accompanied by loss of strength often out of all proportion to the inability to take food; it is quite common to find a patient able to take a large quantity of liquid nourishment and, in spite of this, emaciating to a very marked degree. Pain is frequently absent, but coughing and the expectoration of mucus may be troublesome symptoms; there are the usual signs of stricture of the œsophagus, frequently combined with those of ulceration, and there is an absence of any history of injury. The onset is usually gradual, but may be very rapid. When the growth is situated near the commencement of the œsophagus, the air-passages may become implicated, and the recurrent laryngeal nerve is not uncommonly paralysed on one or both sides. The diagnosis is made by the use of bougies, by means of the œsophagoscope, and by the X-ray screen and radiograms.

TREATMENT.—The treatment of cancer of the œsophagus is at the present time almost entirely palliative. Excision has been practised for growths occupying the upper end of the tube, and in a few cases the patients have recovered from the operation, but recurrence has ensued, In the most of the cases that have been operated on, the trachea has also been involved, so that the operation has been practically an excision of the œsophagus and the larynx combined. Accidents have happened after operation from food passing into the trachea, and in all the cases death has occurred in a few months. Considering the fatality of the disease, the formidable character of the operation, the great mutilation and the short relief afforded to the patient, these operations do not seem advisable.

The treatment must therefore be directed to maintaining the patency of the œsophagus as long as possible and relieving the various symptoms

from which the patient suffers. The patency of the œsophagus is of great importance for the comfort of the patient, as it enables him to swallow not only food, but also saliva. The inability to swallow saliva is one of the most distressing features of cancer of the pharynx and œsophagus. The saliva and mucus are secreted in excessive quantities and accumulate at the back of the throat so that the glottis is constantly being irritated, and there is incessant cough and attempts to get rid of the accumulation. This particular trouble is most marked when the stricture is high up; when low down, there is greater space for the saliva to accumulate in, and it is not brought up so frequently. This symptom is extremely difficult to treat by any means except by Symonds's tubes (*vide infra*); but it is just in the cases where the affection is most troublesome that these are the least useful—namely, when the disease is about the commencement of the œsophagus. The salivary secretion may be, to some extent, diminished by the administration of belladonna or atropine, and the mucus may be made less tenacious and more easily got rid of by gargling with alkaline solutions.

Bougies.—In order to maintain the patency of the œsophagus, bougies are sometimes passed. This is not, however, to be recommended as a method of treatment in malignant stricture, although it is most efficacious in the non-malignant type. Temporary benefit may sometimes result from it, but as a rule its only effect is to irritate the growth, to make it grow more rapidly, and to hasten ulceration with all its evil consequences.

Intubation of the stricture.—A method which may help the patient considerably is the introduction of a tube through the stricture and its maintenance permanently in position. This permanent intubation of the stricture may be effected either by a long tube or by the short one introduced by Mr. Charters Symonds.

The long tube.—This method consists in introducing a long india-rubber tube and leaving it permanently *in situ*. One end of the tube projects through the mouth and the other is passed through the stricture into the stomach. The passage of the tube is facilitated by using a whale-bone or soft metal guide over which the tube is threaded. Once it has been got into position it should only be removed occasionally. The best tube for this purpose is that introduced by Dr. William Hill (see Fig. 65).

It is obvious that a long tube passed through the stricture into the stomach must be not only unsightly but inconvenient for many reasons. The saliva does not pass easily along it, and the food cannot be tasted. The advantage is that it saves the patient from starvation, as proper nutriment can be passed through it in any quantity, and that when in position it need only be removed occasionally, since it cannot suffer from any blocking that simple syringing down the tube will not relieve.

Symonds's short tubes.—These tubes are of great value in many cases, especially when the stricture is situated in the lower part of the œsophagus. The tube (see Fig. 64) is 4 to 6 inches long, of a gauge

varying with the size ot the stricture, and terminating above in an expanded funnel-shaped opening, while below it is furnished with a terminal opening. To the funnel-shaped end silk threads are attached which are brought out through the mouth and fastened round the ear. The tube is inserted upon a special holder until it has passed well into the stricture, the funnel-shaped end resting upon the upper surface of the growth and preventing the tube passing right through. The largest sized tube that will go through the stricture should be chosen, the size of the stricture having been previously ascertained by the passage of a sound. All these tubes should be furnished with a terminal opening, as blockage is apt to occur if the opening is lateral, either from lateral pressure against the stricture or from a collection of food in the blind end. The tube is introduced upon its guide exactly as is a long œsophageal tube, and when it is in place the guide is withdrawn and the silk threads are passed between two of the teeth and fixed

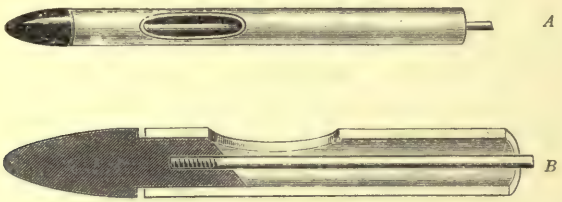

FIG. 65.—DR. WILLIAM HILL'S PERMANENT ŒSOPHAGEAL TUBE. This tube is intended to be worn continuously in cases of stricture of the œsophagus. It is of soft india-rubber fitted with a vulcanite end to facilitate introduction and a malleable silver stylette, the proximal end of which may be attached to a denture or bent round the patient's ear to keep it in position. The stylette also prevents the tube from being coughed or vomited up. *A*, represents the tube full size ; *B*, gives enlarged details of construction.

around the ear. It is difficult to prevent the threads from being bitten through, and the most satisfactory way is to substitute a piece of silver wire for the upper part of the silk. The end of this may be either hooked round the necks of the teeth or may project from the mouth and be fastened to a button outside the lips.

The advantage of these tubes is that they enable the patient to swallow his food, and they avoid the accumulation of saliva that is so distressing. The patient can also taste his food. Unfortunately, however, their usefulness is limited. On the one hand the tubes are more difficult to introduce than the ordinary long form, and it is not uncommon to fail to pass them when the long tube goes in comparatively easily ; this, however, is mainly a matter of practice. A point of greater importance is that, in certain situations, they can only be retained a short time owing to the presssure and irritation that the funnel-shaped end produces. This is particularly the case when the growth is situated at the upper end of the œsophagus, the expanded part of the tube then pressing upon the

larynx and causing cough, spasm, and ulceration and necrosis of the cartilages. When, on the other hand, the growth is low down, the patient is perfectly comfortable, but there is the constant liability to blocking of the tube, especially if any error of diet is committed. Coagulated milk may collect in or about the tube and effectually block it, and perhaps necessitate its removal, and it may be impossible to reintroduce it. If blockage occurs, it is well to try first what passing the whalebone guide down through the tube will do towards clearing it. It is comparatively easy to hit the funnel-shaped opening with the guide, and when this is done it is not difficult to pass it down the tube ; this is another reason why the tube should be fitted with a terminal opening as, if the opening be lateral, the guide does not necessarily clear it when passed down in this manner.

Two accidents may occur with these tubes, neither of which are of any great practical importance, but which require mention, as they may cause uneasiness to a beginner. In the first place, the tube may slip down through the stricture and pass into the stomach. This may result either from undue laxity of the silk threads or because they have been bitten across. In this case nothing should be done beyond endeavouring to insert a tube of larger size. It is well not to attempt to get the tube out of the stomach, even though the silk threads still remain attached and can be handled from the mouth. No harm is done ; the elastic portion of the tube is digested and the rest passes on. On the other hand, the threads may get bitten through whilst the tube is in place, but even in this case no immediate steps need be taken ; as long as the tube acts it will probably remain comfortably *in situ*. Should it fail to act by becoming blocked it will almost invariably be vomited up sooner or later, if it cannot be cleared by passing down the whalebone guide.

Radium.—During the last few years, radium has been extensively used in the treatment of these cases. It is enclosed in a suitable tube which is passed into the stricture, being most easily introduced by means of a direct-vision œsophagoscope. It is left *in situ* for some hours—at the most twenty-four—the application being repeated in the course of five or six weeks. Though occasional benefit has sometimes followed this treatment, as a rule no good has resulted ; indeed, the patient's trouble has been aggravated by the rapid spread of the disease or the early occurrence of mediastinal abscess following sloughing of the growth as a result of necrosis due to the radium.

Gastrostomy.—There comes a time in nearly all cases of cancer of the œsophagus when it is impossible to introduce any tube, and the patient must then starve unless means are taken to introduce food into the stomach below the stricture. For a long time there was a great prejudice against gastrostomy, and this still lingers in the minds of some. This is probably, chiefly, because the old methods were not unattended with danger and did not satisfactorily prevent the escape of the gastric

contents, with its accompanying excoriation of the abdominal wall and suffering to the patient. Gastrostomy properly performed is, however, an excellent operation, relieving the patient's suffering and prolonging his life, always provided that it is performed sufficiently early in the case. Undoubtedly some of the prejudice against gastrostomy, which still exists, may be ascribed to the fact that it is so often left to the very last, when the patient is really not in a fit state to bear the operation.

The following are the main points to be borne in mind in performing gastrostomy. The operation chosen should be one that can be done quickly, as the patients are usually feeble. No operation should be considered satisfactory unless it is planned so as to prevent leakage of the gastric contents through the artificial opening—an event accompanied by intense irritation of the skin around.

There are three operations of high excellence, which we shall describe here: they are those known by the names of Witzel, Kader, and Franck. In Witzel's method an opening is made into the stomach at the time of operation, and a tubular track is constructed extending from this to the skin incision; this serves for the introduction of a tube through which food is poured into the stomach, and it also acts as a valve to prevent regurgitation. In Kader's operation a portion of the stomach wall, with the opening at its apex, is inverted, so as to form a nipple-shaped projection inside the organ, and this acts as a valve to prevent leakage. In Franck's operation the barrier against regurgitation is provided by pulling a portion of the stomach through the abdominal wall and altering its direction so as to make an S-shaped kink. Each operation has its own special indications, but on the whole Witzel's and Kader's operations are applicable to the larger number of cases, as they can be done in a contracted stomach, whereas Franck's cannot.

In all cases of gastrostomy the anæsthetic is a matter of importance. A frequent cause of death after the operation is septic pneumonia due to saliva, mucus, and débris of the œsophageal growth finding their way into the trachea during or after the anæsthesia. Hence it is a good plan to use stovaine spinal anæsthesia in all cases in which the patient's trouble has reached an advanced stage, as the pharyngeal reflex is unaltered and all mucus and the like can be coughed up. The limit of the skin anæsthesia may if necessary be extended by the use of local infiltration (see Vol. I. p. 484).

Witzel's operation.—A vertical incision is made about an inch to the left of the middle line, running about four inches downward from the xiphoid cartilage. The stomach is exposed and pulled up into the wound or, if its size allows, outside it altogether. The rest of the abdominal cavity is carefully packed off with abdominal cloths, and a small opening is made through all the coats of the viscus on its anterior surface about midway between the two curvatures and rather towards the

cardiac end. This opening should be large enough to admit a No. 12 catheter with ease. A sterilised red-rubber (Jaques's) catheter of this size is the most convenient and the tip is introduced into the orifice in the stomach; the remainder is laid along the wall of the stomach running from left to right. A piece of india-rubber tubing is fixed over the outer end of the catheter so that, should the patient vomit, the gastric contents are conveyed away from the wound and do not soil it. The serous and muscular coats of the stomach are now brought up over the catheter on each side by means of Lembert's sutures (see Fig. 66) so as to form a tube about an inch and a half or two inches long; enough of the stomach wall on each side must be taken up to obviate any tension

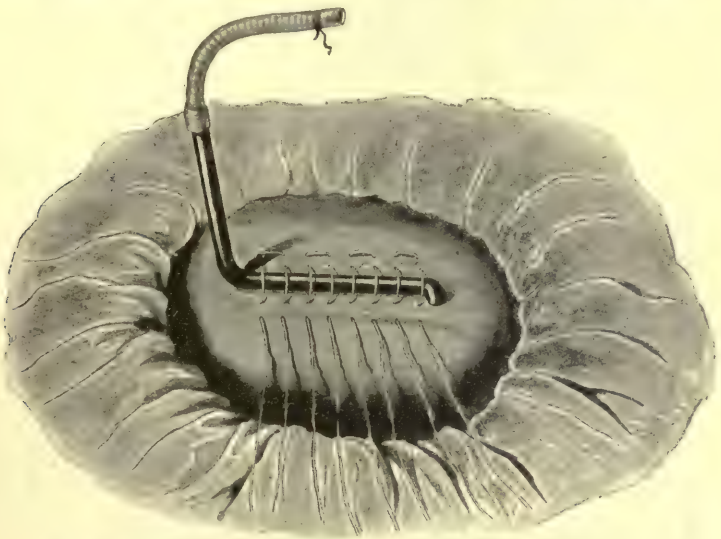

FIG. 66.—WITZEL'S GASTROSTOMY. *Formation of the stomach tube.* The sketch shows the tip of the catheter inserted into the opening in the stomach, and four mattress sutures in place and ready to fold the stomach wall up round the catheter.

on the stitches. Outside this row is applied a second continuous sero muscular suture which should be carried well beyond the point of entrance of the tube into the stomach so as to prevent leakage (see Fig. 67).

The next step is to fix the outer end of this tube of stomach wall to the opening in the abdominal parietes. The peritoneum is sutured above and below leaving a small hole about the centre of the incision through which the tube and the outer portion of stomach folded round it emerges (see Fig. 68). In sewing up the upper portion of the peritoneum it is well to insert two or three of the sutures through the stomach wall as well, so as to bring the line of sutures forming the stomach tube well up beneath the incision. The two opposed surfaces will then become adherent and form an additional means of closing in the tube and will at the same time anchor the stomach firmly to the abdominal wall so that

there is no risk of its dragging away, as it might were it merely stitched round the opening left in the peritoneum. If this precaution is omitted it is quite possible for leakage to occur between the stomach and the abdominal wall. The circle of stomach wall emerging through the opening in the peritoneum is then sutured, first to the edge of the latter, and then to the skin; in order to do this, the tube of stomach around the catheter is pulled well forward by an assistant. The rest of the wound is then stitched up as usual. The catheter thus passes through the skin incision along a tube formed by the folded stomach wall, and at the further end through an opening into the stomach. No regurgitation is likely to occur, as the tube will collapse when the catheter is taken out

FIG. 67.—WITZEL'S GASTROSTOMY. *The catheter secured in position.* This is done by a continuous Lembert suture burying the mattress sutures.

and its walls will be firmly approximated by the pressure of the stomach contents (see Fig. 69).

The patient is fed upon the operating table with six ounces of milk and half an ounce of brandy, and this may be repeated every four hours.

After-treatment.—The wound heals readily and the patient may usually be allowed to get about at the end of a fortnight. The catheter should be changed daily after the first four days, a fresh one being inserted immediately. A piece of india-rubber tubing should be attached to the end of the catheter and provided with a proper clip to prevent escape of the gastric contents; the whole is fastened on with a binder. After about two months the tube may be left out between meals, and only inserted for purposes of feeding. It is well to provide the patient with a black olive-ended catheter for feeding purposes, as its tapering end enables it to be passed into the wound more certainly and with less risk

of damage than the ordinary blunt-ended form. Feeding can be done by the patient himself; he pours the food into a glass funnel connected with the catheter by a piece of india-rubber tubing.

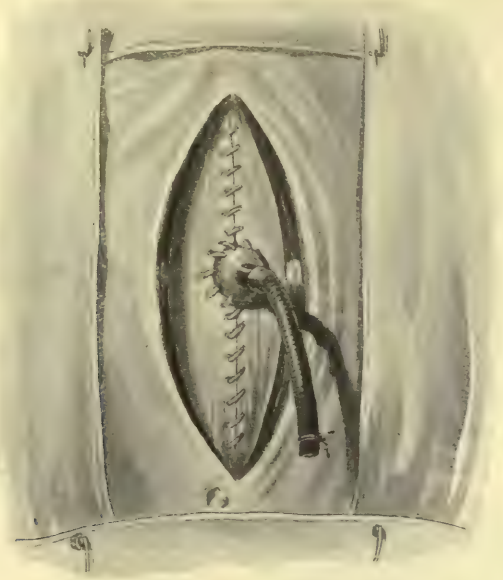

FIG. 68.—WITZEL'S GASTROSTOMY. *The method of securing the stomach to the abdominal wall.* The peritoneum and the posterior layer of the sheath of the rectus are united by a continuous suture which also takes up the muscular wall of the stomach near its centre. The portion of stomach round the tube is also sutured as shown above.

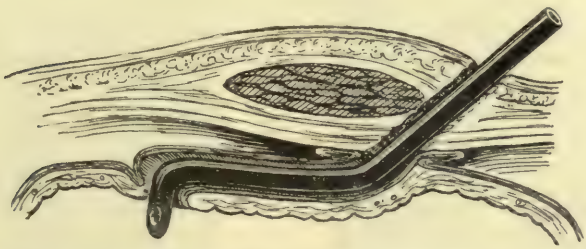

FIG. 69.—HORIZONTAL SECTION IN WITZEL'S GASTROSTOMY. (*Diagrammatic.*) Showing the catheter passing from the interior of the stomach to the opening in the abdominal wall. The tube in which it lies is lined by peritoneum, and not by mucous membrane as is the case in Franck's operation.

Kader's operation.—The abdomen is opened through the fibres of the left rectus muscle, the stomach is exposed at the spot selected for the artificial opening, an incision just large enough to admit a No. 12 catheter is made through all the coats, and this is inserted and fastened in position with a catgut suture which passes through it and the adjacent sero-muscular coat of the stomach. The surgeon then invaginates the

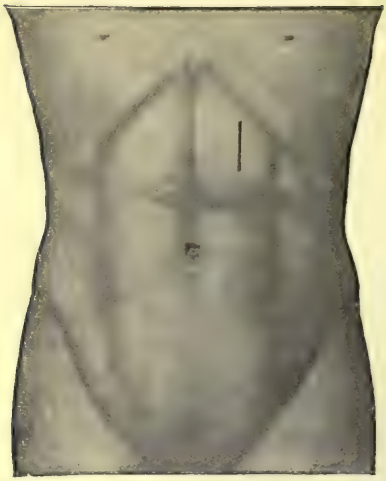

FIG. 70.—KADER'S GASTROSTOMY. *The incision.* (Legg, *A System of Treatment.*)

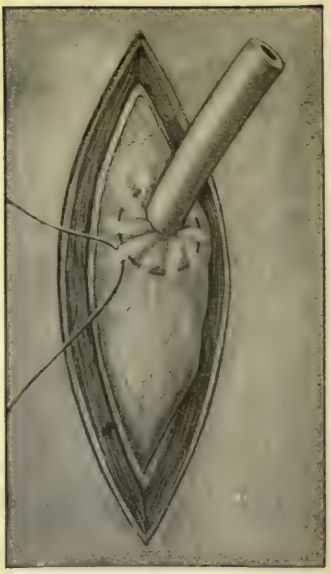

FIG. 71.—KADER'S GASTROSTOMY. *The purse-string suture around the tube.* (Legg, *A System of Treatment.*)

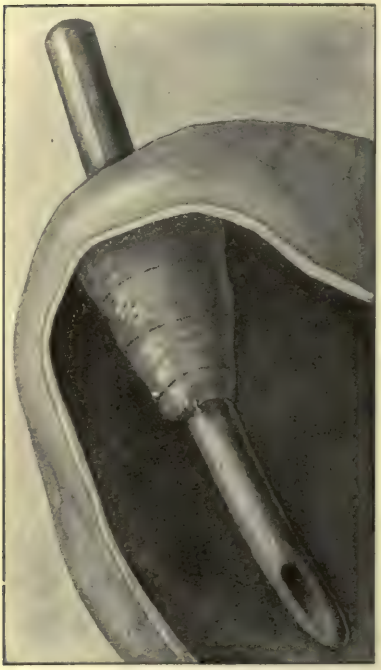

FIG. 72.—KADER'S GASTROSTOMY. *The stomach invaginated round the tube.* The dotted lines represent purse-string sutures at different levels. (Legg, *A System of Treatment.*)

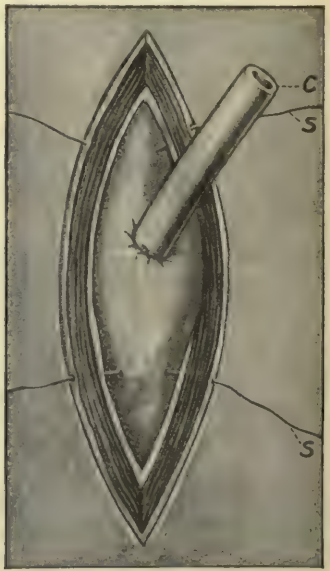

FIG. 73.—KADER'S GASTROSTOMY. *Fixing the stomach to the abdominal wall.* *C*, catheter; *S*, sutures passing through muscular coat of stomach and the abdominal wall. (Legg, *A System of Treatment.*)

portion of the stomach wall embracing the catheter with a few Lembert's sutures introduced at some little distance to either side of the tube or else by a purse-string suture of stout catgut or silk some distance away from it (see Fig. 71). As these sutures are drawn tight, the catheter and the stomach surrounding it are pushed downwards so that the lower end of the catheter is surrounded for an inch or more by a collar of stomach which projects downwards like a nipple into the interior of the viscus (see Fig. 72). This invagination can be made more pronounced, if the stomach be of sufficient size, by carrying another purse-string suture or a second layer of Lembert sutures still further out. The opening in the stomach is now brought immediately under that in the abdominal wall and the viscus is fixed firmly to the latter by four or six sutures (see

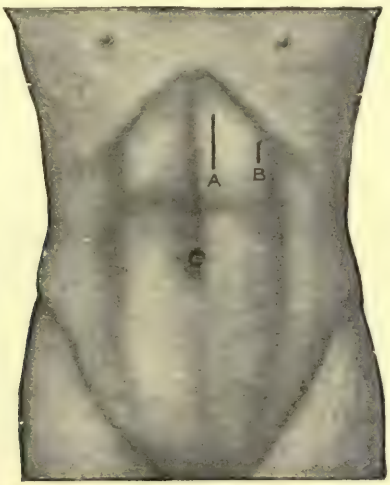

FIG. 74.—FRANCK'S GASTROSTOMY. *The incisions.* *A*, the incision into the abdominal cavity; *B*, the incision at which the stomach emerges. (Legg, *A System of Treatment.*)

Fig. 73) ; the wound is then closed. The after-treatment is similar to that after Witzel's method. When the catheter is taken out, the nipple-like projection into the interior of the stomach prevents regurgitation of the stomach contents.

Franck's operation.—The stomach is exposed as before and as much of its anterior wall is pulled out through the abdominal wound as will come without exerting undue traction. This is given to an assistant to hold whilst the surgeon makes a second vertical incision about an inch long just below the costal margin (see Fig. 74). This only goes through the skin, fascia, and anterior layer of the sheath of the rectus, and this and the original wound are connected by carrying the handle of the knife horizontally through the fibres of the rectus from one to the other ; this forms a canal with a muscular band surrounding it.

The stomach is carried through the canal thus formed, brought out through the skin at the second incision, and the protruded portion grasped by an assistant (see Fig. 75). The stomach is prevented from slipping back into the abdominal cavity by suturing the right-hand edge of the incision in the peritoneum and sheath of the rectus to the adjacent surface of the viscus. It is unnecessary to sew the stomach to the left-hand side of the abdominal incision, as the organ is firmly flexed over this edge. Finally,

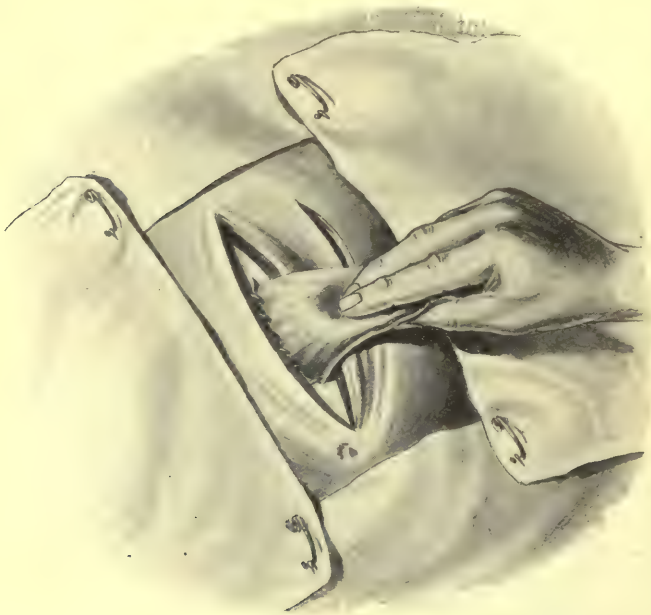

FIG. 75.—FRANCK'S GASTROSTOMY. *First stage.* The anterior wall of the stomach is pulled out through the opening in the posterior layer of the sheath of the rectus just to the left of the middle line. It is held over to the left side and its sero-muscular coat united to the right-hand edge of the incision in the sheath of the rectus by a continuous running suture. The sketch also shows the second smaller incision just below the costal margin.

a few stitches are inserted between the second skin incision and the portion of the stomach wall emerging from it, and if the stomach is not opened at this time it is well to insert two silk stitches into the latter; these are knotted and left long so as to serve as guides when the stomach has to be opened subsequently. The operation is completed by suturing the first skin incision completely. Neither the opening into the abdomen nor the second opening through the skin should constrict the portion of stomach passing through it.

After-treatment.—Some surgeons allow forty-eight hours to elapse

before the stomach is opened; but there is no danger in opening the stomach at the time of the operation and tying in a tube (see Fig. 76). If the opening is delayed, the best way of proceeding is to cut through the serous and muscular coats with a knife between the two guiding stitches until the mucous membrance is reached. The protruded portion of the stomach becomes stiff from inflammatory exudation and the contrast between the rigid muscular walls and the yielding mucous membrane is very marked. The latter is snipped through with scissors, when a little gastric juice escapes and renders it certain that the cavity has been opened; a No. 12 catheter is introduced in the direction of the track, from left to right, and a meal administered. It is inadvisable to attempt to open the stomach by thrusting in a trochar or by cutting across

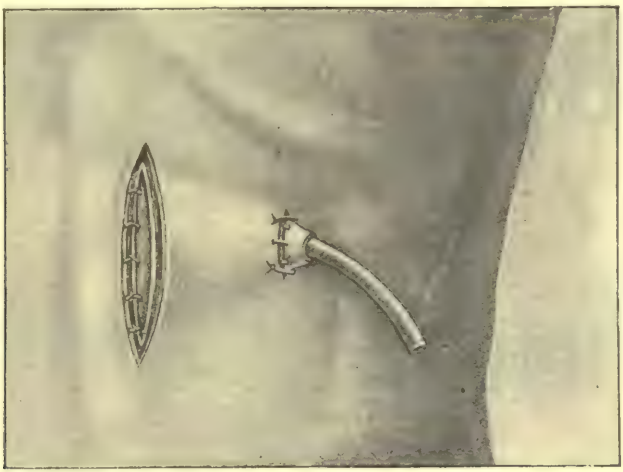

FIG. 76.—FRANCK'S GASTROSTOMY. *The operation completed.* The apex of the cone of stomach has been fastened to the edges of the second incision and a tube inserted. It now only remains to suture the original wound. (Legg, *A System of Treatment.*)

with a knife, as the mucous membrane slips out of the way and should be identified and divided separately. The catheter should be fastened in position until the fourth day, when it may be taken out and merely passed when food is to be administered. The original dressing over the median incision should be changed when the stomach is opened, and covered by a small dressing varnished over with collodion so that the discharge from the stomach will not affect it. Primary union almost always occurs in this wound. The patient should wear a pad of salicylic wool over the opening in the intervals between the feeding; this presses upon the portion of the stomach wall which passes through the abdominal wall, being bent at right angles in two places, and thus prevents leakage of the gastric contents (see Fig. 77). If the patient is very feeble it is best to open the stomach at the time of the operation and administer a meal of milk and brandy through it.

Relative merits of the operations.—*Kader's* and *Witzel's operations* are suited for all cases in which gastrostomy can be performed, and provide an effectual safeguard against regurgitation of the stomach contents. Of the two methods Kader's is perhaps the easier and safer in unskilled hands, but the effectual prevention of regurgitation in Witzel's operation renders it a favourite with those who practise it. In the rare event of a temporary gastrostomy being required one of these two methods should always be used; if closure of the gastrostomy wound is desired, it is only necessary to leave off the use of the stomach feeding tube and the opening will close in a few days. Both methods have the disadvantages that the patient must wear the tube for some considerable time after

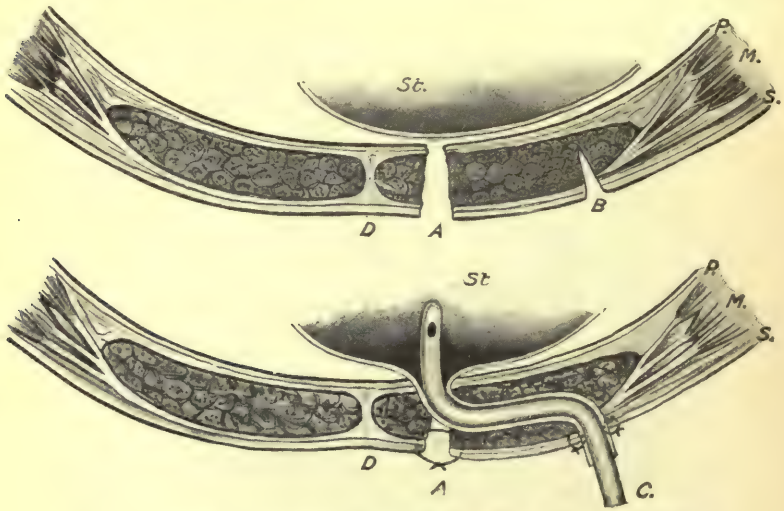

FIG. 77.—FRANCK'S GASTROSTOMY. *Diagram showing the direction of the fistula.* *P*, peritoneum; *M*, abdominal muscles; *S*, skin; *D*, linea alba; *A*, incision through which the stomach is drawn out of the abdomen, and which is sutured at the end of the operation; *B*, incision into rectus through which the apex of the stomach cone emerges; *C*, catheter passed through the fistulous opening into the stomach, *St.* showing its И-shaped course. (Legg, *A System of Treatment.*)

the operation, otherwise the artificial opening tends to close. A disadvantage of Witzel's method is that in inexperienced hands the suture may be faulty and leakage may take place between the stomach and the abdominal wall, and suppuration and possibly fatal peritonitis may occur.

Franck's operation has the advantage that no tube need be worn after the fourth day; and there is no tendency to spontaneous closure even if the patient neglects to use the feeding catheter for a long period; a certain amount of contraction of the orifice does take place, however. It has the disadvantage that it cannot be performed when the stomach is either greatly contracted as in advanced cases of starvation from œsophageal stricture, or when it cannot be pulled out of the wound.

DIVISION III.

THE SURGICAL AFFECTIONS OF THE STOMACH AND INTESTINES.

CHAPTER XIII.

AFFECTIONS OF THE ABDOMINAL WALL.

TRAUMATIC AFFECTIONS.

INJURIES of the abdominal wall may or may not be accompanied by a breach of the skin, and they differ in no way from similar injuries elsewhere, but they acquire importance from the fact that they are often associated with injury to the abdominal contents. Thus, an incised wound may penetrate the abdominal wall and damage the structures in the interior, and even a severe contusion may be associated with the most extensive internal injuries. The first effect of a blow on the abdominal wall is that the muscles contract and protect the abdominal contents up to a certain point. When, however, the blow is severe, the wall yields to the pressure, —especially when it is sudden and the muscles are taken by surprise— and deeper-seated injuries occur. Examples of such injuries are rupture of the stomach, intestines, bladder, liver, spleen, or kidneys. The injuries of the abdominal wall may therefore be divided into two great classes: (1) Injuries limited to the abdominal wall, which in their turn may be (*a*) simple contusions, (*b*) rupture of muscles, or (*c*) non-penetrating wounds; and (2) injuries of the wall accompanied by a lesion of the abdominal contents with or without solution of continuity of the skin.

SIMPLE CONTUSIONS OF THE ABDOMINAL WALL.

This condition is comparatively rare, for the abdominal wall usually yields before a sudden blow and so escapes much bruising; when severe contusion of the abdominal wall is present, there is frequently injury to the abdominal contents as well, and this constitutes the great importance of these cases. Locally, there are the signs of contusion—namely, effusion of blood and tearing of the deeper tissues; this is sometimes associated with rupture of the abdominal muscles (*vide infra*).

TREATMENT.—The patient should be put to bed, and a firm many-tailed bandage of flannel applied around the trunk outside a mass of cotton-wool, so as to support the abdominal muscles and keep them at rest. Shock, if present, must be suitably treated. If a hæmatoma forms it should be treated like a hæmatoma elsewhere; if it is large and does not become absorbed within two or three weeks, the most satisfactory method is to incise and drain it. Hæmatomata situated towards the posterior part of the abdomen are rather prone to suppurate, probably because there is bruising not only of the whole thickness of the abdominal wall, but also of the large intestine beneath, and bacteria may pass directly from the latter into the contused tissues. The patient must be kept quiet in bed. If symptoms of peritonitis arise, they may be due to some unsuspected rupture of the abdominal contents or to deep-seated suppuration in a hæmatoma involving the peritoneum.

RUPTURE OF THE ABDOMINAL MUSCLES.

Rupture of one of the abdominal muscles may occur either from external violence or from sudden contraction of the muscle itself. The latter condition is not strictly an injury of the abdominal wall, but it is convenient to refer to it here.

When a muscle is ruptured as the result of external violence, the one usually involved is the rectus, although some of the lateral abdominal muscles may also be torn. The rupture may be complete, but in the great majority of cases it is only partial.

The injury is associated with sudden severe pain and some degree of shock. Vomiting is not uncommon and the pain is increased by vomiting or pressure. There may be some paralysis of the intestine accompanying the injury, especially when the force has been transmitted to the abdominal contents. In the course of a few hours a hæmatoma forms and may obscure the nature of the injury. As the blood becomes absorbed, the gap in the muscle may become evident to touch, and the thickened ends may be felt above and below, while the abdominal wall may bulge forwards in the interval. When the abdominal viscera are not injured, the patient progresses satisfactorily, but pain on throwing the abdominal

muscles into action may last for some time. When only a few fibres are affected, the pain may be very persistent, and is probably due to adhesion of the torn fibres of the muscle to one another or to other muscles. Ventral hernia may follow at a later period. When rupture occurs in those convalescing from typhoid fever or some other debilitating disease, repair is slow and sometimes complicated with suppuration.

Spontaneous rupture of a muscle not uncommonly follows sudden movement in a patient who is the subject of a debilitating disease and in whom the muscles have undergone a certain amount of degeneration. This is perhaps most common in typhoid fever, and patients convalescing from this affection may rupture the recti when attempting to sit up, or during vomiting or coughing. Rupture of healthy abdominal muscles may also occur during gymnastic exercises or playing tennis or similar games, or as a result of sudden twists of the trunk ; the rupture usually only involves a few fibres of the muscle, but it may give rise to considerable and persistent pain.

The symptoms of spontaneous rupture are similar to those of rupture due to injury. There is great pain at the time of the accident, inability to perform certain movements, vomiting, constipation, and sometimes serious collapse which may lead to suspicion of a strangulated internal hernia or commencing peritonitis. Ecchymosis follows the rupture, and pain may persist for some time.

TREATMENT.—*When the rupture only involves a few fibres* the best treatment is to place the patient at rest for a few days with the shoulders raised so as to relax the abdominal muscles. An ice-bag may be applied for the first twenty-four hours ; after that, gentle rubbing should be employed to promote the absorption of the effusion. If the pain continues, massage should be employed so as to free any adhesions between the muscular planes. Vibratory massage by means of an electrically driven vibrator is a most efficient means of getting rid of painful areas and muscular disabilities after these injuries. Rest should not be continued for more than a week from the commencement of treatment, otherwise pain and stiffness are likely to persist.

When a muscle has been extensively ruptured as the result of an accident, the torn ends must be brought as close together as possible and immobilised in that position ; for example, when the rectus is affected, the shoulders and the pelvis should be raised. If this position suffices to secure approximation of the ends, it should be maintained for two or three weeks, and then extension may be gradually effected ; spontaneous movements of the muscle may be allowed after six weeks. When, however, there is wide separation of the ruptured ends and when it is impossible to bring them together satisfactorily, a better result will be obtained by exposing the torn ends, turning out blood-clot and suturing the ruptured ends of the muscle ; this procedure also enables precautions to be taken against the possible occurrence of a ventral hernia. A

further reason for operation is that when a muscle is completely torn across, the ruptured ends curl up, so that the smooth outer surfaces of the muscle are opposed, and these unite very imperfectly. The method of suture of muscles is described in Vol. II. p. 63.

When the rupture occurs in the course of disease, such as typhoid fever, we have to deal with degenerated muscular fibres, and the chances of sound healing after suture are comparatively slight, quite apart from the fact that the patient is probably not in a condition to stand an operation. Operation is also not so necessary in these cases, because the ends of the degenerated muscle do not tend to curl up as do those of a healthy muscle. We do not therefore suggest operation here.

NON-PENETRATING ABDOMINAL WOUNDS.

These may be inflicted with a sharp instrument, such as a knife or a bayonet, by bullets or by blunt instruments; in the latter case the wounds are contused. The important question in all wounds is whether the peritoneal cavity has been opened, and if so whether there is also injury of the abdominal viscera. In non-penetrating wounds of the abdominal wall there is little shock or bleeding, but the latter varies with the position and nature of the injury. Unless the wound becomes infected and suppuration occurs, the patient recovers rapidly.

TREATMENT.—The first point that should be ascertained in every case is whether the wound penetrates the peritoneal cavity. Before making a full examination the external wound and the skin around must be thoroughly disinfected, so as to avoid carrying infective material into the deeper parts of the wound and possibly into the peritoneal cavity; for it must be borne in mind that even when there is actual penetration, the instrument causing it may not have carried infective material further than the surface, especially if the wound is small. Instead of passing a probe to see if there is penetration of the abdominal wall, the wound should be enlarged so as to expose the opening in the muscles at any rate, and then the deeper parts should be disinfected before going further, taking care that no strong antiseptic gains access to the peritoneum; the condition of the parts beneath the muscles may finally be investigated. If no opening is found in the peritoneum, a small drainage tube should be put in at one end of the wound, and the muscles and skin sutured in layers. A stitch may be passed through the muscles opposite the point at which the drain emerges and its ends knotted and left long, so that it can be tied when it is certain that the wound is aseptic and that drainage may be safely discontinued; this is an important point, as, if a drain is left in longer than two or three days, ventral hernia is extremely likely to occur through the small opening left in the abdominal wall.

When the muscles are divided transversely to their fibres the skin wound must be opened up and the torn muscles stitched together as

described in Vol. II. p. 63. If it is necessary to employ a drain for the parts beneath the muscles, it is best to separate the muscular fibres longitudinally at a little distance from the injury and to insert the drain between the separated fibres. The transversely divided fibres can then be united accurately, whereas if the drain were brought out between them, it would interfere with their union. In these cases a stitch should be passed through the muscle opposite the drain, but its ends should be merely knotted together so that it can be tied at the end of three days if the wound remains aseptic.

ABDOMINAL CONTUSIONS ACCOMPANIED BY VISCERAL INJURIES.

It is very important and at the same time very difficult to determine whether in any given case the injury is limited to the abdominal wall or whether the viscera have suffered also. This point must, however, be decided as soon as possible after the injury, for frequently the only chance of success lies in surgical interference at the earliest possible moment. The viscera usually injured are the small intestines ; the colon lies deeply in the loin, and the stomach high up under the ribs, and they usually escape damage unless they are distended. Fixed portions of the intestines are more liable to rupture than freely movable coils ; for instance, the duodenum may be ruptured by a blow over the upper part of the abdomen, while the more movable coils of the ileum escape. Similarly, inflammatory adhesions fixing the intestines to one another or to the abdominal wall, render the bowel more susceptible to damage. Apart from the intestines, the mesentery or the omentum may be damaged, and fatal hæmorrhage may occur into the peritoneal cavity. The liver, the spleen, or the kidney may also be ruptured.

The gravity of these injuries depends on the fact that, on the one hand, extravasation of the contents of the bowels may occur and lead to a rapidly fatal septic peritonitis or, on the other hand, there may be severe and even fatal hæmorrhage. In both instances, early recognition of the nature of the case affords the only chance of recovery. It is exceedingly rare for patients to recover from severe injuries of this nature without operation.

The most prominent symptoms of visceral injury are prolonged shock, intense and continued pain, and persistent vomiting.

When the solid abdominal viscera have been injured, the chief complication is hæmorrhage and, in addition to this, there may be special symptoms referable to the organ involved. *When the stomach or intestines are ruptured,* there is very severe pain and marked rigidity of the abdominal muscles, with retraction of the abdomen in the first instance. If along with retraction of the abdomen there is obliteration of the liver dullness, this will suggest the presence of free gas in the abdominal cavity which must be due to rupture of the intestinal tract. This sign is of no value,

however, if the abdomen is distended; on the other hand its absence does not exclude rupture of the stomach or intestines. Symptoms of peritonitis soon set in and the condition of the patient becomes rapidly very grave; the dyspnœa becomes intense, there is marked distension of the abdomen, the patient presents the typical abdominal aspect, and death occurs very rapidly. When the bowel has been injured but no extravasation of its contents has taken place, a localised peritonitis may occur and prevent infection of the general peritoneal cavity should perforation occur at a later date; the result may then be the development of a limited abscess in the peritoneal cavity and the subsequent formation of a fæcal fistula.

TREATMENT.—When the immediate symptoms are not urgent, and the diagnosis of an internal injury is not clear, it may be justifiable to wait for a time and to employ remedies for the shock (see Vol. I. p. 117) until the patient recovers slightly. If however the surgeon is in doubt as to the presence of internal injury, he had better make his preparations for operation at once; and if by the time he is ready—which will probably be in about an hour—the condition of the patient has not improved, he had better proceed with the operation. If no injury is found, the patient will be little the worse, while if injury is present, delay may prove fatal. If the surgeon decides to wait, the question whether morphine should be given to relieve the pain and shock is a somewhat difficult one, because, though morphine tends to mask the symptoms, it is beneficial in immobilising the intestines, and thus diminishing intraperitoneal extravasation should rupture have taken place. Unless, however, the pain is very severe, it is well to avoid its use; but when pain is excessive, a small dose (gr. $\frac{1}{6}$) may be given hypodermically. The patient should be kept lying on his back, with the knees flexed and tied together over a pillow, and nothing should be given by the mouth. If the phenomena of shock disappear in a few hours and no peritoneal or other symptoms arise, it may be presumed that no serious internal injury has occurred.

On the other hand, if the severe collapse, the small rapid pulse, and the subnormal temperature continue, if persistent vomiting sets in, or if there is increase of the pain and commencing distension, it is well to open the abdomen without delay. Should hæmatemesis, obliteration of the liver dullness or tympanites be present, operation is imperative. The abdomen should be opened by an incision close to the middle line unless the history or the symptoms make it almost certain that the injury is to one side. If, for instance, there has been a severe blow over the liver, the gall-bladder, or the spleen, rupture of one of these structures may be suspected, and it is then better to make the incision over the seat of injury.

Exploratory laparotomy for abdominal contusions.—In all these operations special attention must be paid to the diminution of shock. This

question is dealt with in Vol. I. p. 117; in the cases under consideration continuous subcutaneous infusion of sterilised normal saline solution at the body temperature during the operation may be employed with advantage and this should be followed by continuous proctoclysis (see Vol. I. p. 115) afterwards. The operation must, if possible, be performed in a well-heated room (70°–75° F.) and carried out as rapidly as possible. As the operation is accompanied by severe shock in itself, and as, in addition, the patient is profoundly collapsed before the commencement of the operation, it is of the highest importance to have everything ready before the anæsthetic is commenced. The shaving and purification of the abdominal wall, the arrangement of towels and other preparations should be carried out before the anæsthetic is administered. The preliminary injection of morphine (*vide supra*) will greatly diminish the pain that this would otherwise cause. The anæsthetic should be a mixture of chloroform and ether, or ether alone, given by the open method. The bladder must be emptied by a catheter, and it is a good plan to give an enema containing two ounces of hot beef-tea and one ounce of brandy a few minutes before the patient is placed on the operating table.

After the abdomen has been opened, the first thing is to inspect the interior by simply separating the edges of the abdominal incision without disturbing the parts.

The first thing that meets the surgeon's eye on opening the peritoneum may be extravasated blood, and it is then important to investigate its source. If there has been much hæmorrhage, blood will gush out as soon as the peritoneum is divided, and the amount may be so great that the surgeon may conclude that it is pouring out of some big vessel; this may not be the case, however, as it may only be blood that has accumulated in the peritoneal cavity. Until this has been got rid of to some extent, it will be practically impossible to ascertain the source of the hæmorrhage, and, therefore, the edges of the abdominal wound should be held wide open, and the sides of the abdomen gently pressed together so as to squeeze out most of the blood as quickly as possible. The remainder may be mopped up from the surface, and then an attempt made to ascertain by sight from what direction the bleeding comes. Information may be gained by noticing its distribution, or by seeing whether it wells up from any particular region as it is sponged away. Vascular organs, such as the liver and the spleen, should be examined first unless the seat of the hæmorrhage is obvious; if wounded, they should receive appropriate treatment (see Vol. V.). Bleeding which does not come from these sources is probably from the omentum or the mesentery, and these structures should then be examined methodically in this order and any bleeding points secured (see Chap. XXI.). Hot abdominal cloths will be required to receive and cover the intestinal coils as they are brought out of the wound.

If the gastric or intestinal contents are free in the peritoneal cavity,

some clue as to the site of the rupture may be obtained by examination of the extravasated material; thus a sour-smelling fluid containing undigested food without any fæcal odour suggests a rupture of the stomach; if the food is partially digested but devoid of intestinal odour, it is suggestive of injury to the duodenum; if the material is distinctly fæcal, the small intestine or the large must be examined first according to the characteristics of the material present; the contents of the small intestine will be liquid and yellowish in colour, whilst those of the large bowel are semi-solid or contain hard masses and are dark brown or black. These points should be noted before the viscera are disturbed. The surgeon is often saved a tedious search, and the prospects of the patient are proportionately improved by the fact that in many cases the seat of injury lies immediately beneath the abdominal incision when this is made over the seat of the blow. Any injury severe enough to damage the intestine generally arrests the peristaltic action at once, so that the injured bowel lies in the position that it occupied at the time of the injury.

A wound of the stomach or intestine must be repaired in the appropriate manner. Sometimes the intestine is not only ruptured but is also so severely bruised as to render its recovery impossible, and it will then be necessary to excise the injured portion; the technique of these various operations is described in connection with wounds of the stomach and intestines respectively.

When neither blood nor intestinal contents are seen on opening the abdomen, it is well to investigate the condition of the intestines before closing the wound, because the damaged portion may possibly have become displaced and covered in by healthy coils. The search must be made methodically and in the following manner. The first step is to raise the omentum so as to expose the intestines, for the omentum may prevent fæcal material or hæmorrhage from the mesentery coming into view at once; the intestines should next be gently pressed back from the abdominal wall, so as to allow the escape of any extravasated material from either side. If neither blood, intestinal contents, nor gas be thus found, the probabilities of a severe intestinal lesion are much diminished; at the same time it is not advisable to close the abdomen without further inspection, because, on the one hand, a rupture of the intestine may be so small that the orifice is temporarily plugged by prolapsed mucous membrane, but will nevertheless lead to infection of the peritoneum if left untreated, or on the other, the mesentery may be so bruised and its vessels so injured that subsequent gangrene of the bowel will occur. Hence it is well to inspect the coils of the intestine methodically, but without allowing them to escape from the abdomen. First of all the surgeon slips his hand in towards the cæcum, and, grasping the extreme lower end of the ileum at that spot, he passes the entire small intestine through his fingers, coil by coil, packing each loop away towards the right side of the abdominal cavity as it is examined; any injury to the intestine

or its mesentery will be evident at once. The duodenum and stomach should also be looked at, and the colon examined from the cæcum downwards ; if all these structures are found intact the abdomen may be closed.

PENETRATING ABDOMINAL WOUNDS.

When the instrument that produces the injury penetrates the abdominal cavity, it may or may not inflict injury upon the abdominal contents. If the abdominal viscera are injured, the symptoms will be very similar to those of similar injuries produced by contusions of the abdomen (see p. 197), but there will not be the same degree of shock. It is of the highest importance to ascertain at the earliest possible moment whether such damage has occurred or not, and therefore the wound should be enlarged at once and the abdominal contents examined in the manner described above.

The symptoms are similar to those of non-penetrating wounds, and the treatment (in so far as concerns the examination necessary to determine whether the abdominal contents are damaged or not) will be the same ; when there is no damage, the abdominal wound should be treated in the manner described on p. 196. If the abdominal parietes are carefully sutured, there will not be much likelihood of a subsequent ventral hernia.

Prolapse of portions of the viscera through the abdominal wound.—Apart from injury to the abdominal contents, serious trouble may result from immediate prolapse of portions of the viscera through the opening. When the wound is large, extensive prolapse of the contents of the abdomen may occur through the opening in the skin. When the opening is small and the patient is very fat, the bowel may prolapse through the rent in the peritoneum and remain lodged in the sub-peritoneal tissues, giving rise to an interstitial hernia. The abdominal contents that prolapse are omentum—which usually prolapses first—intestine, or stomach.

This condition adds very much to the gravity of the case. There is considerable risk of infection of the peritoneum from soiling of the protruded mass, the occurrence of the protrusion itself adds to the shock, and strangulation may ensue whether the protrusion be external or interstitial, more especially if the bowel itself protrudes. The possibility of an interstitial hernia is a strong reason for opening up these abdominal wounds at once, for it is important not only to ascertain whether the wound is a penetrating one or not, and to sew up the abdominal wall so that no subsequent protrusion is likely to occur, but also to see that no protrusion has taken place into the sub-peritoneal tissues ; such an occurrence may escape notice until too late unless the wound is opened up.

It is obvious that the prognosis and treatment must vary according as the prolapse is seen immediately after its occurrence or as a considerable

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time has elapsed before the surgeon is called in; in the latter case, the protruded portion may have undergone profound alterations and contracted adhesions.

(*a*) **Treatment of recent prolapse.**—When the case is seen immediately after the occurrence of the injury, two problems present themselves. In the first place it is necessary to cleanse the protruded mass, which may be soiled either from contact with the ground or with the clothes, and if returned in that state would give rise to peritonitis. In the second place, when the protruded mass contains intestine it is necessary to ascertain whether the bowel has been injured; as a rule the injured portion will be found in the protruding coils.

The first step is to disinfect the protruded mass and the surface of the abdomen and also the wound through which the prolapse has occurred. A certain routine should be followed in all these cases. After aseptic cloths have been spread over the abdomen the whole area is irrigated with a stream of hot normal saline solution (105° F.) flushed upon the protruded mass with some force so as to carry away all coarse particles. The protrusion is then gone over carefully with a sponge, and all recesses exposed so as to make sure that every portion has been cleansed. The omentum should be spread out upon a sterile towel and should be ligatured and removed if it is much soiled. The relation that the protruded part bears to the remainder of the omentum must be ascertained before this is done, as, if the central part only is protruded and is cut away, the lower end will be deprived of its blood-supply. The omentum should therefore be pulled well out of the wound and the protruded portion removed right down to its free edge.

The next step is to disinfect the abdominal wall around the wound, and, while this is being done, the protruded mass (which has already been cleansed) is covered with an abdominal cloth. The skin wound is then enlarged and, if necessary, that in the peritoneum also, so as to allow the prolapsed mass to be returned. The finger is slipped down beside the protruded mass and the opening is enlarged either with blunt-pointed scissors or a probe-pointed bistoury.

The peritoneum is now closed with a continuous suture, and after that the muscles and skin are united by through-and-through stitches. A drainage tube should be employed for a short time. If the prolapse has been grossly soiled and there is any doubt about the thorough cleansing of the protruded mass, it is as well to insert a drain into the abdomen in the immediate neighbourhood of the protrusion. A temporary stitch is passed through the abdominal wall at this point and is tied when the drain is removed. The after-treatment is the same as for exploratory laparotomy (see p. 209).

(*b*) **Treatment of long-standing prolapse.**—When the protrusion has lasted some time before the surgeon sees it, sepsis will certainly have occurred, there will be adhesions between the extruded structures and the wound,

and in all probability the abdominal cavity will be completely shut off. When the opening is small, there may also be symptoms of strangulation; indeed the patient may not be seen until actual gangrene of the omentum or the intestine has taken place. The conditions in these cases are therefore totally different from those seen immediately after the accident, and different treatment is called for. It would never do to reduce the protrusion into the abdominal cavity without previous disinfection, for this would probably entail a fatal peritonitis.

When the protrusion is formed by the omentum and not more than two days have elapsed since it occurred, the abdominal wall and the protruded portion should be cleansed in the usual way (see Vol. I. p. 100), the prolapse being scrubbed just as the cutaneous surface is scrubbed, and then the adhesions to the soft parts around should be detached and the omentum freed and pulled out until the healthy portion is reached. The protruding portion is then ligatured and cut away and the stump is dropped back into the abdomen; the peritoneum, muscles, and the skin are sutured in the usual manner, and a small drainage tube leading down through the peritoneum to the stump of the omentum is inserted for two or three days.

When intestine is present, but has not yet become strangulated, a good deal will depend upon whether the coil is covered by omentum or is exposed. In the former case the treatment is the same as for protruded omentum (*vide supra*); the latter is disinfected, carefully separated and cut off, the stump dropped back into the abdomen, the bowel reduced, and a drain inserted. When, however, the intestine is not covered by omentum, the protruded portion should be cleansed and returned just within the abdominal cavity after enlarging the opening through which it has emerged; ample provision for drainage must then be made. A good plan is to leave the wound freely open for two or three days, keeping the prolapsed coil of intestine lying at the bottom of the wound, which is carefully packed with gauze so that adhesions will form early and shut off the general peritoneal cavity. It is also well to introduce a series of silkworm-gut stitches through skin, muscles, and peritoneum and to leave these loosely knotted together at the ends. If no suppuration or peritonitis occurs after three or four days, the packing is gradually reduced and stitch after stitch is tied so as to decrease the wound in the abdominal wall.

When the intestine has been prolapsed for some time and strangulation has occurred, the case must be treated as a gangrenous strangulated hernia. If the patient's condition warrants it, the strangulated portion may be excised and the bowel reunited, whereas, if the general condition is grave, an artificial anus is made by cutting away the strangulated portions, tying in Paul's tubes, and leaving the closure of the openings in the bowel to a later date. In the majority of cases the latter procedure is to be preferred, as the wound is generally foul, and an attempt

to open it up, pull out fresh intestine and then to excise, re-unite, and put the bowel back would be very apt to be followed by septic peritonitis, whereas the patient usually makes a good recovery after simple removal of the strangulated bowel, and may be got into a good state for a subsequent plastic operation.

In some cases (though very rarely in civil practice) the omentum alone may have been protruded for several days before the patient comes under the surgeon's notice. Here the protruding portion will probably be granulating, and it is better to leave matters alone, merely applying antiseptic dressings. A laparotomy would be very likely to be followed by sepsis, whereas, if the omentum is left alone, it shrinks up and ultimately cicatrises. When this has occurred, the surgeon may excise the protruded portion and repair the defect in the abdominal wall with the object of preventing a ventral hernia.

INFLAMMATORY AFFECTIONS.

Inflammation of the abdominal wall may be (*a*) superficial, (*b*) between the abdominal muscles, or (*c*) in the sub-peritoneal tissues.

(*a*) **Superficial inflammations** generally take the form of cellulitis and local suppurations of the abdominal wall, such as boils, which present no points of difference from superficial inflammations elsewhere.

(*b*) **Intermuscular suppuration** in the abdominal wall may follow contusions, punctured wounds or debilitating diseases such as typhoid fever, especially after spontaneous rupture of one of the muscles. These abscesses present no points of special interest.

(*c*) **Suppuration in the sub-peritoneal tissues.**—The most important of the inflammatory affections of the abdominal wall occurs beneath the muscles in the sub-peritoneal tissue. The most common seats of this inflammation are about the umbilicus, between the bladder and the pubes, in the epigastrium and in the lumbar region. It may occur in the course of general infective diseases, such as puerperal or typhoid fever, or it may be due to the presence of the pneumococcus. It may be connected with affections of the abdominal contents, such as injuries to the duodenum, or disease of the cæcum or the colon, the infection spreading from the intestinal canal to the cellular tissue around. It may also occur in connection with biliary calculi, in connection with the kidney or with disease of the spine or pelvis. Lastly, it may complicate bladder affections or be secondary to peri-uterine inflammation.

The abscess tends to spread rather towards the exterior than to the peritoneal cavity and is accompanied by extensive induration, which may persist long after the abscess has been opened. The pus is frequently fœtid, but this is rarely from an actual communication with the intestinal canal; it is due to the presence of the *Bacillus coli communis* which has found its way from the intestinal canal.

These affections give rise to very varied *symptoms*, the earliest of which, such as abdominal pains, colic, fever, and slight distension of the abdomen, are generally referred to digestive troubles. In the early stages it is not easy to make an accurate diagnosis; this must remain tentative until a distinct tumour has formed. The abdominal wall is usually tense for some distance around the area of inflammation; when this occurs in the hypogastric region it may be accompanied by frequent and painful micturition, and similar trouble may arise when the suppuration is in the loin. It is difficult to distinguish these cases from peritonitis, but the pain is more limited, there is not the same distension of the abdomen, and vomiting is not a prominent symptom. On the other hand, the symptoms may be very slight at the commencement, and the swelling may be mistaken for a tumour, especially when the liver region is affected. In some cases gas is found in the abscesses, especially when the colon bacillus is present; the diagnosis is then still more difficult.

The general condition of the patient is bad, the contents of the abscess being particularly poisonous, especially if the *Bacillus coli communis* is present, and hence the abscess should be opened as soon as possible; a leucocyte count will generally be helpful (see Vol. I.). In many cases, more particularly when the abscess is situated in the loin, fluctuation is not easy to make out at an early stage, and may not be evident until the pus reaches the subcutaneous tissues. Nevertheless it is not advisable to wait for evident fluctuation, for by that time the abscess may have become very extensive. When the acute symptoms have lasted for four or five days, it is almost certain that pus has formed, and an incision should then be made over the indurated area and the tissues bored through until the pus is reached. Even should no pus be found, the incision will afford relief.

TUMOURS.

There is little to be said about these; ordinary simple tumours may occur, the most frequent being *lipomata* (especially in the sub-peritoneal tissue), and *fibromata* in connection with the fascial coverings of the muscles; *desmoids* (see Vol. I.) are not infrequently found in the anterior abdominal wall. The chief point of importance in the diagnosis is whether the tumours are inside or outside the abdominal cavity, and this is not always easy to make out, especially in the case of large tumours situated laterally on the abdominal wall. The chief points to notice are whether the tumour is an integral part of the abdominal wall and whether it moves with it on respiration and not with the abdominal contents; for instance, when the patient takes a deep breath, the abdominal wall is not raised from the tumour as it would be were the latter within the abdomen, and when the patient is rolled over to one side the tumour does not change its position as it would were it freely movable inside the

abdomen. At the same time it is often impossible to be sure until an incision has been made. The treatment is the same as for similar tumours elsewhere.

SUB-PERITONEAL FATTY HERNIA.

Small fatty tumours which are formed by protrusion of the sub-peritoneal fat through openings in the abdominal fascia, are not uncommon about the linea alba above the umbilicus. These form small rounded, subcutaneous tumours, which are often intensely painful and require removal. They are sometimes really herniæ of the omentum or of an appendix epiploica and then cause severe dyspeptic symptoms which distinguish them from the true fatty tumours of which we are speaking.

TREATMENT.—The protruding fat should be removed and the hole in the fascia sewn up transversely. It is well to enlarge the hole and to free the fat for some distance around it, as it is not so much the protruded portion that causes the pain as the adhesion of the sub-peritoneal fat and possibly the peritoneum to the sides of the slit. The condition will be permanently cured if the slit is closed, and this is also a safeguard against a subsequent ventral hernia.

Among other tumours of the abdominal wall may be mentioned those which occur at the umbilicus in infants. Here a simple tumour of an adenomatous character belonging to the class of *teratomata* may arise about the time of the separation of the cord. *Myxomata* may also be met with in that situation, while, later on in life, *epitheliomata* are not uncommon. They should be removed when possible.

RETROPERITONEAL TUMOURS.

Retroperitoneal tumours may be divided into two great groups—namely, those lying behind the peritoneal cavity and those occurring in the mesentery. The latter are discussed in connection with the mesentery (see Chap. XXI.) ; but we may here refer briefly to the first form. These chiefly occur in the lumbar region and usually originate in the peri-renal fat. The majority are simple tumours belonging to the classes of lipomata, fibro-lipomata and fibromata. Sarcomata also occur in this region. The tumours may attain a very large size and extend from the diaphragm into the iliac fossa and across the middle line in front of the great vessels. Only the simple tumours are really amenable to surgical interference, but, as they are encapsuled, they may often be shelled out even when they are very large.

The diagnosis is by no means easy. The tumours are often mistaken for growths of the spleen, the kidney, or suprarenal capsule, or ovarian cysts. The important point is that the intestines (and especially the descending

colon) can often be made out in front of them, whereas in splenic and ovarian tumours this is not the case. If they reach as low as the pelvis they can usually be pushed up by the finger in the rectum and an interval can then be made out between the pelvic organs and the tumour ; this serves to distinguish them from ovarian tumours. In the case of a renal tumour there are usually some indications such as hæmaturia or albuminuria, pointing to implication of that organ. The simple tumours may be distinguished from malignant ones by their slow growth, the absence of cachexia and a certain amount of mobility, which, however, may only be made out when the patient is under an anæsthetic.

These tumours may cause the patient a great deal of trouble from their size ; the chief symptoms are a dragging sensation, pain from pressure on the lumbar plexus, often nausea and vomiting, which interferes with the nutrition of the patient, dyspnœa from pressure on the diaphragm, jaundice from pressure on the bile-duct, or obstruction of the bowels.

TREATMENT.—The removal of simple tumours is desirable and has been carried out successfully even though the tumour has been of large size. Some surgeons advise that the peritoneal cavity should be opened, the intestines pushed out of the way, the posterior layer of the peritoneum incised, and the tumour shelled out. For large tumours, however, a large curved incision in the lateral region of the abdomen similar to that used for large kidney tumours (see Vol. V.) gives better access. The muscular wall of the abdomen is divided, the peritoneum defined and separated forwards and pushed aside, the capsule of the tumour opened and the growth shelled out. Special care must be taken in separating the tumour over the large vessels, especially the vena cava, and, should the growth penetrate into the mesentery, injury to the mesenteric vessels must be avoided. If any large mesenteric vessel is divided, the nutrition of the corresponding portion of the bowel will be affected, and in that case it will become necessary to open the peritoneum and excise the portion of bowel which would otherwise become gangrenous. Similarly, care must be taken in separating the kidney not to injure the renal vessels, and in separating the spleen not to tear that organ. Should either of the latter accidents occur, the organ involved must also be removed. As a rule, however, if the capsule of the tumour is opened, the growth can be shelled out without serious trouble. If the peritoneum has been opened, it should be sutured, and the wound in the abdominal wall stitched up without drainage.

CHAPTER XIV.

GENERAL REMARKS ON LAPAROTOMY : INTESTINAL SUTURE.

TREATMENT OF THE PATIENT BEFORE AND AFTER EXPLORATORY LAPAROTOMY.

THE preparation of the patient in cases of abdominal operations has reference only to operations for chronic disease ; in acute cases, no time can be wasted in preliminary measures. Practice varies very much as regards the amount of time and care devoted to the preparation of the patient before an abdominal operation ; some surgeons keep him in bed for several days in order to accustom him to the restraint and to teach him to lie in the dorsal position. Such a long time is not really essential, and nervous patients may be much upset when they are kept waiting for several days ; but it is helpful if the patient will give up the time to become used to the dorsal decubitus. In most cases a couple of days before the operation will suffice for the preparation of the patient ; and if possible, the day before the operation at any rate should be spent in bed. In all cases it is well to attend to the teeth, and if there is pyorrhœa alveolaris this should be treated by a dentist. It is well also to put the patient on a restricted and practically fluid diet for twenty-four hours previous to operation. Some advise that only boiled food should be given, and maintain that by cleaning the teeth and administering boiled food, the upper part of the alimentary canal can be rendered aseptic, especially if this treatment is continued for several days. It is very doubtful, however, if this is really the case, but certainly the patient will be more comfortable after an abdominal operation if the condition of the stomach and intestines has been attended to beforehand. The bowels must be thoroughly evacuated before the operation, and it is well to administer a purgative, preferably castor oil, two nights before the operation. Given at that time, the irritating effect of the purgative on the bowels will have completely

passed off before the operation. On the day preceding the operation a soap-and-water enema should be given, and on the morning of the operation the rectum should be washed out about an hour before it takes place. In cases in which the stomach is thoroughly out of order, or the operation is to be performed on the stomach, a stomach tube should be passed and the stomach washed out on the day preceding the operation, and again just before the anæsthetic is administered. If the patient is nervous, a narcotic should be administered on the night preceding the operation, so as to give him a good night, and morphine (gr. $\frac{1}{4}$) with atropine (gr. $\frac{1}{100}$) are the best for this purpose. Further, in some cases, gr. $\frac{1}{4}$ of morphine and gr. $\frac{1}{100}$ of scopolamine may be administered hypodermically about an hour before the operation, and if this is done a much smaller quantity of anæsthetic is necessary. In feeble patients or in cold weather, it is well to clothe the trunk and the limbs with thick gamgee tissue so as to keep them warm, and also to administer a pint of saline solution (temp. 100° F.) containing an ounce of glucose, *per rectum*, about an hour before the operation. In very feeble patients it may be well also to introduce saline solution into the axillæ during the operation; about 12 to 14 ozs. can be slowly injected into each axilla. The preparation of the skin has already been described (see Vol. I. p. 100). The choice of the anæsthetic must be left to the anæsthetist, but the best seems to be ether given by the open method. In very feeble patients the shock is apparently less if the operation is done under spinal anæsthesia.

After-treatment.—The bed should be warm; but unless the patient is very collapsed, all hot bottles should be removed before he is put back to bed. If however the collapse is severe, the hot-water bottles may be placed around him outside the blankets, but on no account must they be put close to the body, otherwise burns are extremely apt to occur. If electric light is available, a better and safer plan is to hang two or three 32-candle power lamps from a cradle placed over the thorax and extremities and covered with a blanket. If the operation has been prolonged or severe, a saline enema should be administered, containing an ounce of glucose, and after an hour or so, continuous protoclysis may be commenced (see Vol. I. p. 115). In chronic cases the patient should be placed in the recumbent position in the first instance, but he will be more comfortable if the trunk is raised on pillows after the lapse of two or three hours. In the case of acute suppurative affections, such as appendicitis, Fowler's or the semi-recumbent position should be employed from the first, and this is also advisable in cases of gastro-jejunostomy. If there is much pain after the operation, the cause must be ascertained; if it is due to tightness of the bandages, these should be loosened; if to distension of the bowel with gas, an enema should be given, and a flatus tube passed. Aspirin and trional (gr. 10 of each) may also be administered by the mouth if there is no great amount of vomiting. The use of morphine should be avoided as much as possible, because this often leads

to marked distension of the bowel and also to headache and nausea or vomiting. Heroin (in doses of gr. $\frac{1}{12}$) seems to do less harm than morphine, and when the pain is severe, it may be repeated in an hour or two. The arrangements as regards food and the action of the bowels depend to some extent on the conditions for which the operation has been performed; three of these may be mentioned:

1. Cases in which the alimentary canal has not been interfered with and the bowel has not been opened; for example, operations for gall-stones, for hernia, or on the pelvic organs.

2. When incisions have been made into the bowel or stomach, or portions of the alimentary canal have been removed.

3. When the operation is in connection with an acute inflammatory condition of the bowel.

In the first class of cases, the patient may be given small quantities of hot water as soon as the chloroform sickness has passed off, and later two ounces of milk and water may be administered every hour. This may be supplemented after a few hours with Benger's food, and albumen water, beef tea, or chicken broth with rusks may also be administered. As soon as the bowels have acted, soft solids are given, and in about a week the patient may be placed on ordinary diet. A purge should be administered on the day after the operation, and salines followed by an enema are the best. Some surgeons administer calomel in half-grain doses every hour until three or four grains have been taken, but calomel has often a depressing effect on the patient and is not so good as salines.

In the second class of cases it is important not to irritate the stomach or the bowel unnecessarily; but at the same time, if the operation has been properly performed, there ought to be no danger of leakage, and therefore fluids, especially hot water, may be given from the first. The diet must be more carefully attended to in these cases than in the former, any food being avoided which is likely to upset the stomach or the bowels, or to give rise to flatulence; in stomach cases care as regards the diet should be exercised for a considerable time, according to the morbid condition present.

When the small intestine has been the seat of operation, it is well to defer the administration of a purgative by the mouth for two or three days, so as not to set up any violent peristaltic action which might strain the stitches. In the case of the large intestine, the fæcal matter becomes hard if the action of the bowels is delayed too long, and may unduly stretch the seat of union, and therefore in these cases it is well to begin with frequent small doses of salines about the second day so as to render the contents of the bowel liquid. The best compound for the purpose is the ordinary hospital white mixture which may be administered in two-dram doses every two or three hours until about a couple of ounces have been taken. If no result follows at the end of twelve hours, a full dose (an ounce or more) may be administered. Teaspoonful

doses of liquid paraffin twice a day are also helpful. When very much discomfort or distension of the bowel is present and the seat of the operation is above the large intestine, considerable relief may be obtained by passing a long tube up the bowel, or by the use of enemata, such as a pint of soap-and-water containing two ounces of turpentine or an ounce of turpentine and half an ounce of tincture of assafœtida. A very excellent enema is one containing three drams of confection of rue and twenty ounces of infusion of chamomile. A smaller enema may be used consisting of twenty minims of oil of rue to six ounces of emulsion of starch.

Relief of severe flatulence may sometimes be obtained by the administration of eserine salicylate (gr. $\frac{1}{100}$ every four hours for five or six doses), and also by the employment of pituitary extract. When the large intestine has been resected or opened, enemata are not safe, because they may reach the seat of union, and, especially if containing irritating substances such as turpentine, may endanger the healing.

In the third class of cases, it is well not to use purgatives in the first instance, and it is better to wait until about the end of the second or third day before giving medicine by the mouth. Relief from flatulence can usually be obtained by the enemata referred to in the previous paragraph, the insertion of the long rectal tube, or the administration of eserine or pituitary extract. Great care must be taken not to force the feeding of the patient; as a rule, he can do without a large amount of nutriment for several days—water, or albumen water, or milk and water being administered in small quantities; the thirst may be allayed by saline rectal enemata.

Any special points in the after-treatment will be referred to in connection with the various diseases.

EXPLORATORY LAPAROTOMY.

Laparotomy is performed under varying circumstances, but considering the difficulty of making an accurate diagnosis in abdominal diseases, there is always a certain element of doubt as to what will be found, and therefore in a certain sense all laparotomies are exploratory, and the surgeon must always be prepared for some condition other than the one he expects. The term 'exploratory laparotomy' is usually applied, however, to cases in which there is great uncertainty as to the diagnosis, and the operation is performed with the view of clearing it up. The conditions under which the operation is done and its technique vary according as it is done for an acute or a chronic disease. When the condition is acute and the surgeon is satisfied that he has to do with a surgical affection and not with a general medical ailment, no time should be wasted in investigations to determine the finer diagnosis, *e.g.* between

a gangrenous gall-bladder and a gangrenous appendix; between various acute pelvic conditions, and so on; all that can be done is to arrive at some approximate idea from the symptoms, as to the nature and seat of the trouble, so as to determine the sort of condition that has to be dealt with, and the most suitable place for the incision. This is discussed in connection with acute abdominal troubles; here we shall only consider the chronic conditions for which an abdominal exploration may be advisable.

In chronic abdominal conditions, exploratory laparotomy is only one of various methods of diagnosis, and should only be undertaken after careful consideration. It should not be looked on as a trivial operation to be undertaken lightly and to replace other diagnostic methods; on the other hand too much time must not be devoted to the latter methods, otherwise conditions, such as malignant disease, which might have been remedied had surgical intervention taken place at an early stage, may become inoperable owing to the unnecessary amount of time spent in medical investigation and treatment.

Exploratory laparotomy is not altogether a trivial operation, although no immediately serious result ought to follow the operation; there are, nevertheless, some disadvantages associated with it. The occurrence of sepsis is one. Suppurative peritonitis should not of course occur, but milder forms of sepsis leading to adhesions is very common. The occurrence of adhesions is in most cases due to bacterial infection, which may be introduced by the hands or instruments or from the skin of the patient; the infection is however mild, either because the bacteria introduced are but slightly virulent or because they are present in too small numbers. The bacteria may also come from the air; in the case of a prolonged investigation, for example, dust must fall into the wound in varying amount, and although it does not usually contain pyogenic organisms—at any rate in sufficiently large numbers to cause suppuration—a certain amount of bacterial growth may occur, sufficient to cause the formation of peritoneal adhesions which may be a source of trouble to the patients afterwards. Extensive peritoneal adhesions are practically always the result of mild sepsis, but slight adhesions of the omentum to the line of incision may occur from portions of the omentum being caught between the peritoneal edges during the closure of the wound.

Besides the occurrence of adhesions, it is remarkable how much a simple laparotomy may upset a patient, and how long it may be before he regains his normal condition; this is especially the case when he is below par. Laparotomy in malignant disease, when no remedial measure is found to be possible, has in many cases a distinctly deleterious effect and may hasten the end.

The practical conclusion is that in the first place obscure abdominal diseases should be recognised as being on the border-line of surgery and medicine, and that the best results will be obtained by the joint association

of the two branches of the profession. The surgeon should be associated with the physician at the early stage in these cases ; it should not be left to the latter to spend a long time in preliminary investigation and treatment before obtaining surgical advice, nor to determine alone when such advice should be called for. On the other hand, unless in cases in which an immediate diagnosis is a matter of urgency, surgical intervention should not be carried out, until an attempt has been made to obtain some light on the state of matters by other means. These means are referred to in speaking of the various abdominal conditions ; they consist in observation of the symptoms—such as pain, tenderness, or flatulence, of the shape of the abdomen, its mobility, the presence of swelling, of dilated coils of intestine, of rigidity, of vomiting, the condition of the bowels, the results of palpation, the size and character of various organs, the presence of fluid, digital examination of the rectum or vagina, the use of various instruments such as the sigmoidoscope, cystoscope, or stomach tube, chemical examination of the contents of the stomach, or of the fæces or urine, the use of test meals, radiographic examination—especially by the use of bismuth meals—and so on.

As the result of these investigations a definite diagnosis and decision as to treatment may be arrived at, or if not, a good idea may be formed as to the probable seat of disease, and the possibility of improving the condition of the patient by operation. Further, if an exploratory laparotomy is decided on, the best position for the incision may be indicated, there will be less disturbance of the contents of the abdominal cavity, and the surgeon will be prepared to proceed at once with any remedial operation that may be found to be necessary.

If however it is evident that the condition is irremediable, there is no object in opening the abdomen. At the same time pessimism must not be carried too far ; conditions that appeared unpromising have turned out on investigation to be amenable to surgical treatment.

In performing an exploratory laparotomy, the preparation of the patient should be carried out on the lines laid down on p. 208, and it is most important that the surgeon should be prepared to go on to any further operation that may be found desirable. The position of the incision will be determined by the previous investigations, but in most cases (especially when the indications are indefinite) it will be vertical and to one side of the middle line. Whether it should be at the upper or lower part of the abdomen will depend on what has been made out, but when the condition is uncertain, it is best to make it so that the umbilicus is opposite the centre of the incision which can then be prolonged upwards or downwards if necessary. The incision should be large enough to admit the hand, which is introduced so as to explore the whole of the abdominal cavity. In the first instance the condition of the peritoneum can be ascertained and then the cæcum and appendix should be examined. In most cases the cæcum can be brought to the opening, especially if the latter

is well retracted to the right side. In the female the next point is to examine the condition of the uterus, tubes, or ovaries. Attention should next be directed to the gall-bladder and bile ducts, and then to the stomach and pancreas ; the kidney can also be readily palpated. If the symptoms point to some intestinal lesion, the intestine can be systematically palpated, beginning with the large intestine from the cæcum downwards, and then the small intestine from the ileo-cæcal valve upwards (see p. 200). Any suitable remediable procedures should then be carried out, the incision being enlarged upwards or downwards as may be necessary, or fresh incisions made over the seat of the trouble.

TREATMENT OF THE ABDOMINAL WALL AFTER LAPAROTOMY.

After the operation has been finished, the abdominal incision must be closed, and it will save repetition if we describe the treatment of

FIG. 78.—EXPLORATORY LAPAROTOMY. *Dissecting up the skin from the external aponeurosis.*

the abdominal wall in cases of laparotomy in general. The method of dealing with the opening in the abdominal wall varies according as the muscular fibres have been divided or merely separated, and according as a septic condition has been dealt with or not.

Operations in which the muscular fibres have been separated—of which the typical example is the ' gridiron ' operation for removal of the appendix—leave a strong abdominal wall, with practically no risk of hernia. As the muscular fibres have only been separated (though a few may have been torn across if there has been much difficulty in getting out the appendix), they fall together after the operation, and movements of the abdominal wall approximate and close the sides of the wound. Nevertheless, it is well, after the operation, to put in a few stitches to keep the separated muscles in place, and this is especially necessary as regards the tendinous portion of the external oblique, the edges of which are apt to remain somewhat apart unless they are brought together. The procedure we adopt is the following: After the operation has been completed and the abdominal contents returned, the edges of the peritoneum are seized with forceps and closed by a continuous catgut suture; the edges of the separated and often somewhat torn fibres of the internal oblique and transversalis muscles are brought into apposition by two or three interrupted catgut sutures, and then the tendinous edges of the external oblique are also united by interrupted catgut stitches. The skin wound is then closed by a continuous suture of silk or other material according to the fancy of the operator.

When the incision has been made vertically on the inner or outer side of the rectus, more care must be taken in closing the deep part of the wound. In these cases the best plan is to make the incision to one side of the middle line, because repair in the latter situation only occurs between fibrous structures, and some weakness through which a hernia may occur is very likely to be left. The incision therefore should be made at least an inch to one side of the middle line so that in deepening it the fibres of the rectus are separated instead of the fibrous interval between the recti being divided. The skin incision should be carried down to the deep fascia, and when the latter is reached it saves time to dissect up the skin and fat for an inch on each side (see Fig. 78) as this is necessary to enable the abdominal wall to be stitched satisfactorily together at the end of the operation. The anterior layer of the sheath of the rectus is now divided vertically, and the fibres of the muscle are separated with the handle of a knife sunk into them so as to leave a considerable portion of muscle on the inner side of the separation; if one of the transverse bands of the rectus comes in the way it should be divided with the knife. In some cases it is better to separate the anterior sheath from the surface of the rectus and displace the muscle either outwards or inwards; it falls back afterwards and covers the deeper parts of the incision. The posterior layer of the sheath is then exposed and divided vertically (see Fig. 79); but it should not be separated from the peritoneum, otherwise it is difficult to bring the edges of the latter together afterwards. The peritoneum is now opened by a vertical incision (see Fig. 80).

In sewing up the wound afterwards, the cut edges of the peritoneum

and posterior sheath of the rectus are seized with tenaculum forceps, brought together by an assistant and united by a continuous suture of silk; if an attempt is made to sew up the peritoneum separately the stitches generally cut through. The fibres of the rectus are then approximated by a few interrupted catgut stitches. The anterior layer of the sheath of the rectus is next united by a button-hole silk stitch and the skin is closed by a silk suture in the ordinary manner (see Figs. 81–84).

When the incisions have been made in the lateral wall of the abdomen

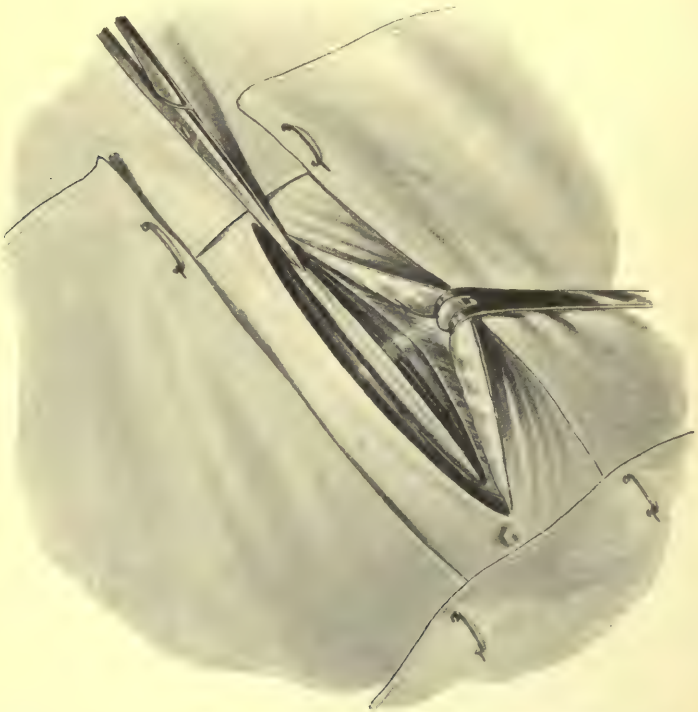

FIG. 79.—EXPLORATORY LAPAROTOMY. *Opening the peritoneal cavity.* The scissors are dividing the posterior layer of the rectus sheath and the peritoneum.

and the muscular fibres have been divided, great care is necessary in order to obtain a strong union, and this is especially difficult when the patient is very muscular. In the first place the peritoneum and the transversalis fascia, which are not detached from each other, are separated from the muscles and brought together by a continuous silk suture. The under surfaces of the divided transversalis and internal oblique are then brought into apposition by a series of mattress sutures of strong silk (see Fig. 85), and then the cut edges which now project forwards are united by a continuous silk suture. In some cases it is impossible to unite the

peritoneum separately, as the stitches cut through, and under those circumstances the mattress sutures through the deeper muscles should take up the peritoneum as well. The edges of the external oblique muscle are then brought together in a similar manner by mattress

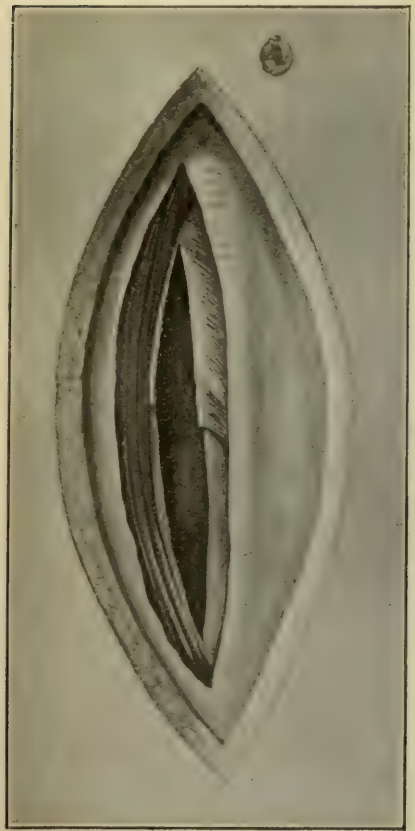

FIG. 80.—EXPLORATORY LAPAROTOMY. *The peritoneal cavity opened.* Deep to the fibres of the rectus is seen the posterior layer of the sheath of the rectus, terminating below in the semilunar fold of Douglas and exposing the fascia transversalis lower down.

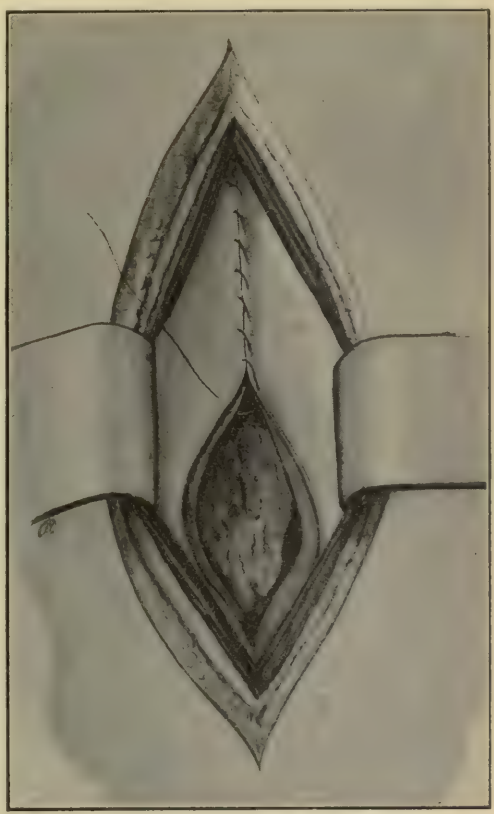

FIG. 81.—SUTURE OF AN ABDOMINAL WOUND IN FOUR LAYERS. *First layer.* The peritoneum and the posterior layer of the sheath of the rectus are united by a continuous 'glover's' suture of catgut; at the lower part of the incision the omentum is shown drawn down over the abdominal viscera.

sutures and a continuous suture of silk, and finally the edges of the skin are united in the usual manner.

After laparotomy the ordinary antiseptic dressings are employed, but as there is usually very little oozing from the wound, only a small dressing need be employed and this can often be fastened on with collodion if desired. At the same time, however, the support of a bandage is of considerable value as it fixes the abdominal wall, and we usually employ a many-tailed bandage applied firmly round the abdomen from below

upwards. Failing this—which, however, can readily be made—an ordinary bandage may be employed and a sheet pinned firmly outside it. After laparotomy there is usually considerable distension as the result of flatulence, and the bandage may have to be loosened in the course of a few hours, otherwise the patient may suffer a good deal. A great

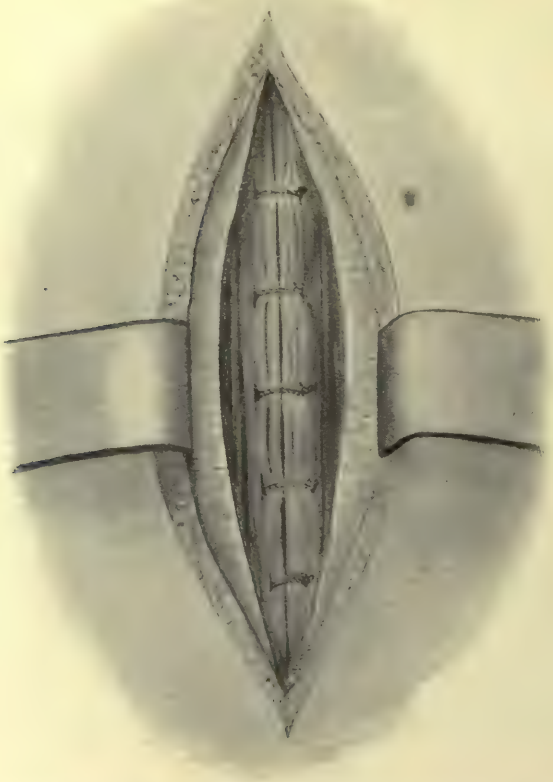

Fig. 82.—Suture of an Abdominal Wound in Four Layers. *Second layer.* The abdominal muscles have been drawn together by a series of interrupted sutures inserted at right angles to the direction of the muscular fibres.

advantage of a many-tailed bandage is that it can be loosened without disturbing the patient.

After-treatment.—The dressing need not be changed for about ten days, when the stitches may be removed and a small collodion dressing applied. The abdomen should be supported by a many-tailed bandage or a binder for about three weeks. In operations performed by splitting muscles rather than dividing them, no subsequent pad or belt is required, whether the incision be to one side or near the middle line. The patient

may be allowed to get up after the end of three weeks or earlier in 'gridiron' operations, and, provided he takes no violent exercise for a short time afterwards, may be considered perfectly well. When the muscles have been divided it is well to wear a belt for three or four months until the

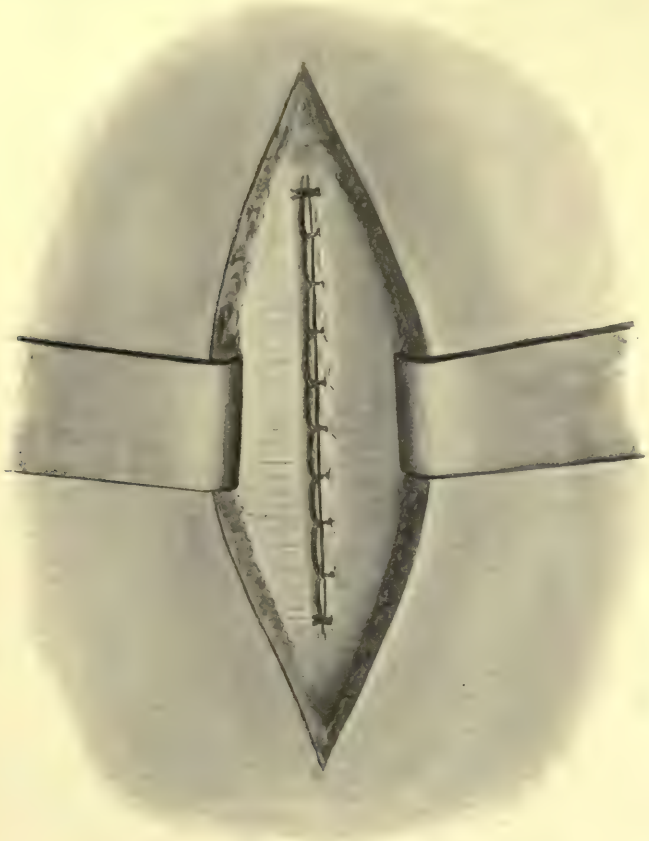

FIG. 83.—SUTURE OF AN ABDOMINAL WOUND IN FOUR LAYERS. *Third layer.* The anterior layer of the sheath of the rectus is closed by a continuous suture of fine silk.

union has become quite firm; if there is then no sign of hernia the belt may be discarded.

In cases in which a septic condition has been dealt with, it is not advisable to bury sutures of whatever material they are composed, as they are very apt to separate and this means a very prolonged healing. Under these circumstances, it is best to bring the abdominal wall together by a series of interrupted stitches of silkworm-gut or silk passing through all the layers including the skin, a continuous suture being also inserted

to unite the edges of the skin. These 'through-and-through' stitches are left in for at least a fortnight even though they may cut through the skin to some extent.

When laparotomy is performed for the evacuation of an abscess the incision must be made over the abscess cavity. In some cases, in which an intra-abdominal abscess has been present for some time, the intestines are not only matted together so as to enclose the pus in a cavity, but they

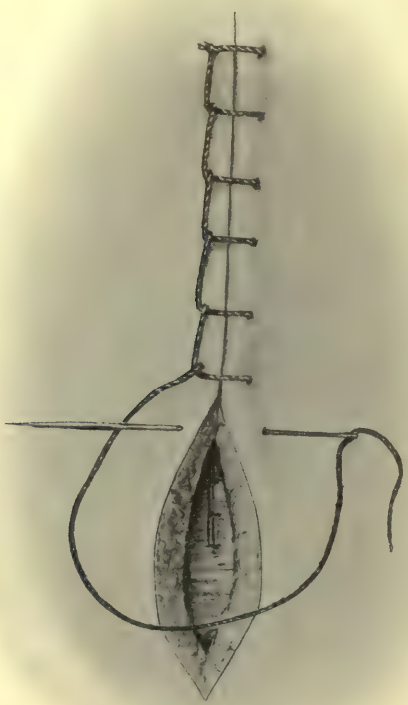

FIG. 84.—SUTURE OF AN ABDOMINAL WOUND IN FOUR LAYERS. *Fourth layer.* The incision in the skin is being closed by a continuous silk suture.

are also adherent to the abdominal wall and therefore an incision made directly over the inflammatory focus will probably be in the adherent region and will run little risk of infecting the peritoneum. In these cases, however, subsequent drainage is imperative, and a hernia through the scar afterwards can hardly be avoided, and it is in them that hernia after operation is most common nowadays. In order to avoid this complication the incision should be as small as possible and the muscular fibres should

be separated instead of being divided. When, however, there is a large abscess for which drainage through a wide opening has to be provided, it is not possible to do this efficiently through any incision which simply separates the muscles, as the tube is apt to be nipped and proper drainage thereby defeated. Hence we are accustomed in the first place to make a free incision through the skin, which of itself is a matter of no consequence, then to separate the muscles over the spot at which the abdomen is to be opened, in the manner already described, so as to expose the peritoneum. This is then opened, and the finger is made to penetrate the abscess by separating the adherent structures immediately beneath, and proper drainage is provided for by large drainage tubes. In order to prevent

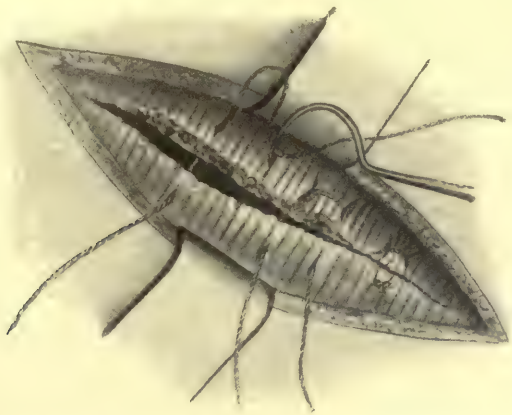

FIG. 85.—SUTURE OF MUSCLES BY THE MATTRESS STITCH. This suture is used when the muscular fibres have been divided transversely.

these being too tightly grasped by the muscles, the latter should be divided transversely sufficiently to leave a free passage. By proceeding in this manner the least possible damage is done to the abdominal wall, and in fact the only weak spot left is the hole through which the tube comes. Unfortunately, in a good many cases—especially when the abdominal walls are flabby—this defect in the wall remains after healing, and protrusion is apt to occur and may necessitate an operation for its closure, but the method has the advantage that if a hernia does occur, it is through a small aperture instead of being a general bulging of the scar as was formerly common.

When the abscess has not yet reached and become adherent to the abdominal wall, the method of opening and dealing with it is much more complicated, but this is fully considered in the chapter on appendicitis.

INTESTINAL SUTURE AND METHODS OF DEALING WITH WOUNDS OF VISCERA.

The surgical treatment of wounds of the stomach and intestine is by no means a modern subject, but has been considered at various periods in the history of surgery. No real progress was however made until it was pointed out by Joubert at the beginning of the last century that in order to obtain proper union, serous surface must be opposed to serous surface. His method, however, had the fault that the sutures were applied in such a manner that they penetrated all the coats. As a consequence, leakage of the contents of the intestine was very apt to occur along the track of the suture. A great advance was however made not very long afterwards by Lembert, who recognised the drawbacks of through-and-through sutures, and carried his stitches only through the serous and part of the muscular coats. Lembert's method of suturing still remains the basis of intestinal work and the plan now generally adopted in closing openings in the hollow viscera is to apply two layers of sutures, an innermost layer uniting the whole thickness of the walls, and an outer layer applied on Lembert's principle.

Operations on the alimentary canal have to be performed for various reasons, of which the following may be mentioned: To close simple incisions which have been made into the viscera for purposes of exploration of the interior, or in order to remove foreign bodies or tumours, such as polypi, which project into the interior; to close wounds inflicted accidentally or by other means than the surgeon's knife, ruptures, and so on; to close perforations; to enlarge the lumen of the canal; to unite portions of bowel which have been divided—for example, in the removal of a tumour of the intestines or of gangrenous intestine; or to form a union between different parts of the intestinal canal as in the operation of gastro-jejunostomy, or in anastomosis between various parts of the intestine. The exact details of the methods applicable for these different purposes will be given under the various headings. A few remarks may, however, be made on the methods of union in general, and especially on the union between different parts of the bowel.

What has already been said with regard to Lembert's sutures will suffice as regards cases in which an incision has been made into the lumen of the intestine. The cut edge is united by a continuous through-and-through suture, and this line of union is buried by a continuous Lembert's suture applied all around it, so as to invaginate and shut off the deeper layer of sutures. The sutures are applied in various ways, but the most convenient seems to be a running continuous stitch (see Fig. 86).

When portions of the intestine have been lost, and there is consequently some tension on the line of junction, it may be advisable to

use interrupted mattress sutures in place of the continuous suture—at any rate, another inner line of stitches. This is especially the case in operations performed with the view of enlarging the lumen of the cavity—for example, in the operation of pyloroplasty. Here a longitudinal incision is made into the lumen of the bowel, dividing the narrowed portion, and in order to enlarge the lumen, the incision is subsequently stitched transversely. Naturally, there is very considerable tension on the stitches which are applied between the two ends of the longitudinal incision, and in these cases it is well to employ a series of through-and-through mattress sutures with a layer of Lembert's sutures outside (see Fig. 87).

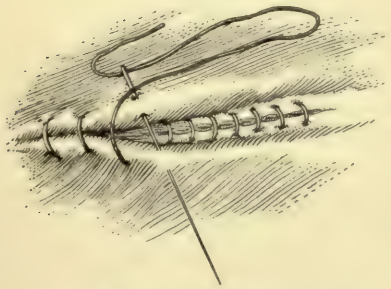

FIG. 86.—CONTINUOUS LEMBERT SUTURE. The suture is shown burying a row of continuous 'through-and-through' sutures.

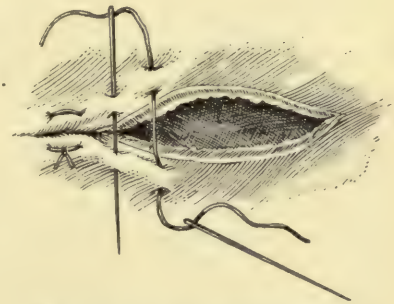

FIG. 87.—INTESTINAL MATTRESS SUTURES. These are used to bring the edges together where there is much tension, and are seromuscular only.

When the sutures are applied with the view of closing perforations, such as occur in connection with an ulcer, and are therefore associated with thickening and rigidity of the wall of the intestine and the tissues in the vicinity, it is seldom possible to approximate the actual edges of the opening, and therefore it must be closed by one, or preferably two, rows of Lembert's sutures, the deeper row being applied in the mattress form.

The greatest amount of work, however, has been done with regard to the union of the ends of divided bowel, especially end-to-end union. The ends may be united directly by a double row of sutures, the deeper row penetrating the coats and the superficial being in the form of Lembert's sutures. The chief difficulty in these cases, is in connection with the union of the mesenteric attachment of the intestine, where it is not easy to get a satisfactory surface for union without stripping off the mesentery to too great an extent, and therefore leakage is apt to occur at this point of the junction. Another objection to the direct circular suture is that the lumen of the bowel is apt to be constricted at the line of union. Various plans have been introduced with the view

of overcoming these objections, and these will be referred to in their proper place.

Another plan which has been a good deal used is to strip off the mucous membrane for a short distance from the distal of the divided ends, and then to push the other portion of the intestine into the interior and sew this cuff on to the portion of the intestine so introduced. With the view of preventing constriction of the intestine during suturing and also of facilitating the union, many artificial aids have been introduced of which we may specially mention Mayo Robson's bone bobbins. These enable the line of union to be quickly and accurately united without undue constriction of the canal.

Perhaps the apparatus which has attained the greatest popularity has been Murphy's metal buttons, which consist of two halves, one of which is introduced into each end of the bowel; the intestine is then drawn in by a circular suture over the stem of the button, and then the two halves are locked together and the wall of the bowel is approximated. There are many objections to Murphy's buttons, and their use has been generally abandoned. For instance, if the button has been badly applied, it may cause gangrene of the bowel and lead to perforation; it may become blocked by fæces; fistulæ may form; bleeding may occur; the button may be a long time in separating; it may remain *in situ* or it may pass upwards instead of downwards and require removal by a second operation.

We have already referred to some of the objections to end-to-end suture, and though a certain diminution in the calibre of the intestine may not be of great importance in the case of the small bowel, it may seriously interfere with the action of the large intestine. This to some extent is remedied by dividing the bowel obliquely so that the two surfaces which come into apposition have a larger diameter than if they were simply divided at right angles to the canal. Among other difficulties is the risk of non-union, especially at the junction of the mesenteric borders already referred to. With the view of strengthening the junction, omental grafts have been much recommended. These may be used in two ways. In the one a thin piece of omentum is entirely detached from the rest and is wrapped round the line of union; it generally retains its vitality and adheres to the line of union and thus forms an additional barrier against the escape of intestinal contents. In the other the piece of omentum is left attached at its base so as to have a certain amount of vascular supply. When the omentum is thin, however, the latter plan is not necessary, and it is objectionable, as it leads to an adhesion of the intestine to the omentum and may give rise to disagreeable symptoms.

Another difficulty in connection with end-to-end union is that the calibre of the two portions to be united may not be the same, and leakage may therefore occur. This is especially marked in the case of

the stomach ; when pylorectomy has been performed, the divided end of the stomach is very much larger than that of the duodenum. A similar condition occurs when the end of the small intestine has to be united to the large intestine, and again when, for some reason or other (for example, the existence of a cancerous growth), the intestine above the obstruction has become much distended and its circumference is much larger than that of the intestine below the growth.

The difficulty of uniting these tubes of dissimilar calibre has led to the introduction of two other methods of restoring the continuity of the canal —namely, lateral implantation and lateral anastomosis. In the case of lateral implantation the end of the larger tube is completely sewn up and a fresh opening is made in its wall some distance above, to which the open divided end of the smaller portion of intestine is attached. With the view of greater security, this open end is usually inserted into the larger portion and then a double row of Lembert's sutures are applied through the serous and muscular coats. This method is practically only applicable in cases in which the larger portion of the canal is below the smaller—for example, in excision of the cæcum and implantation of the ileum into the ascending colon. Here, however, there is the same difficulty as regards the union of the mesenteric border which has already been referred to, and this operation of lateral implantation is now very seldom employed.

By far the safest method of uniting two tubes of dissimilar calibre is *lateral anastomosis* ; and in the case of the intestine, the anastomosis is made between the convex surfaces at the point most distant from the mesenteric border. When a portion of the intestine has been removed, —for example, in excision of a cancerous mass—both ends are completely sewn up, the deeper stitches being through-and-through, and the superficial being continuous Lembert's sutures, and then the two portions of intestine are brought together side by side and the union of the convex borders is effected at a sufficient distance from their ends. On account of the difficulty of getting at the deeper part of the union, it is best to begin by applying a layer of Lembert's sutures at that part. The intestine, should be previously clamped—preferably, by some form of clamp (see Fig. 95) which maintains the relative position of the two portions throughout the operation. The anastomotic opening is now made and its edges are united by a series of through-and-through sutures. The Lembert's suture is then continued around the anterior part of the junction.

In performing any form of lateral anastomosis, it is well to make the opening fairly close to the closed end of the intestine, so that no large bag is left in which intestinal contents may accumulate. Lateral anastomosis may also be employed without division of the intestine, two portions of the bowel being applied side by side and united as above without division of the ends. If that is done, care must be taken

that the peristaltic wave shall drive the contents of the upper part of the intestine in the same direction as in the lower ; this means that a loop must be formed in the upper part. If the coils of intestine are simply laid side by side the peristaltic wave will drive the contents up against the obstruction instead of downwards along the canal.

CHAPTER XV.

THE METHODS OF EXAMINATION OF THE STOMACH.

MANY stomach affections which were formerly left under the care of the physician are now amenable to surgical treatment, and the surgery of the stomach has assumed a position of great importance. We may enumerate some of the cases in which surgical measures are necessary. The various forms of injury to the viscus, such as contusions, ruptures, or incised wounds naturally call for surgical treatment, while foreign bodies that remain located in the organ require removal. It may be necessary to open the stomach in order to remove a foreign body from the lower end of the œsophagus, or to treat a stricture in that situation, or to establish a permanent opening through which the patient may be fed (see Chap. XII.). The chief affections, however, that have come into the domain of surgery of recent years are simple gastric ulcer with its various sequelæ, and malignant disease. In cases of simple ulcer, the surgeon may have to intervene on account of excessive hæmorrhage, or to excise the ulcer or to perform gastro-jejunostomy; operation may also be necessary to save the patient's life when an ulcer has perforated; or an abscess due to a localised peritonitis accompanying perforation may have to be opened. Stenosis of the pylorus (congenital or acquired), the condition known as 'hour-glass contraction,' or extensive adhesions between the stomach and neighbouring parts, all of which interfere with the action of the organ are also conditions which call for surgical treatment. Operation is now frequently employed in cases of cancer of the stomach, either for the purpose of excising the tumour, or, if that is not possible, of establishing a connection between the stomach and the jejunum.

Before proceeding to operation it is necessary to make as accurate a diagnosis of the condition present as possible, and in doing so a number of points must be taken into consideration and various methods of investigation must be employed.

THE SIGNIFICANCE OF PAIN AND VOMITING.

The presence of *pain* is of great importance, and its characters, situation, and mode of onset must be considered. Pain immediately following the ingestion of food is often indicative of ulcer of the stomach, and when the pain is referred to the particular spots mentioned on p. 256, it is very characteristic of ulcer and its situation. On the other hand, a diffuse pain of a neuralgic character may merely indicate some nervous affection. When the pain occurs some time after taking food, it is more suggestive of ulcer of the duodenum.

When vomiting is present, regard should be paid to its frequency, the character of the vomited matters, and the quantity brought up. For example, in dilatation of the stomach, vomiting may occur at infrequent intervals—sometimes only every second or third day when the stomach is much dilated—and the quantity brought up is proportionately large. On the other hand, in simple ulcer of the stomach vomiting often occurs soon after food, and the pain is relieved by it. Again, vomiting due to intestinal obstruction bears no distinct relation to food and is often accompanied by persistent retching. The smell of the vomited matters may be characteristic ; for instance, in dilatation of the stomach the vomit usually has a yeasty odour, whereas in cancer the material vomited is generally foul, and in intestinal obstruction it soon becomes fæcal. The presence of blood in the vomit may be strongly indicative of the true nature of the case. Profuse hæmorrhage generally implies a simple ulcer. The frequent and constant admixture of a little blood with the vomited matters, especially if these smell badly, usually points to cancer of the stomach ; in ulcer of the duodenum, blood in the vomited matter is less common and more usually appears in the stools as melæna ; when it occurs in the stomach contents it is often in the form of ' occult blood ' (see p. 235). Profuse hæmatemesis also occurs in cirrhosis of the liver, but here the blood is usually very dark in colour, the bleeding being venous.

INSPECTION OF THE ABDOMEN.

Mere inspection of the abdomen rarely gives much information as to the condition of the stomach. In thin patients, suffering from pyloric obstruction, either congenital or acquired, however, it may be possible to observe peristaltic movements of the stomach immediately after taking food. In cancer of the pylorus the tumour may sometimes be large enough to be evident, or the greatly dilated stomach may be seen through the abdominal wall. When there is an ' hour-glass contraction ' of the stomach accompanied by flatulent distension, the outline of the organ may be seen through the abdominal parietes and the true nature of the condition may be suspected. In acute dilatation of the stomach the character and degree of the dilatation is often very characteristic.

INFLATION OF THE STOMACH.

This method of diagnosis must be used with great care. It should never be employed when there has been recent bleeding from the stomach and only with the greatest caution when there is the least suspicion of a gastric ulcer, for bleeding or even perforation may occur if the stomach be over-distended. The inflation should be stopped at once should pain result. There are two ways in which the stomach may be inflated; the simplest is *by the administration of effervescent solutions.* A dose of tartaric acid (gr. x–xx) is swallowed, and this is followed immediately by a similar amount of bicarbonate of soda dissolved in water. This plan has the disadvantage that the distension is not sufficiently under the surgeon's control and might be used in a stomach that will not bear dilatation and cause great distress or even possibly actual rupture.

A much better plan is to inflate the stomach *through an œsophageal tube.* A soft rubber tube, similar to that employed for washing out the stomach, is passed into the stomach (see p. 236), and a Higginson's syringe or a bicycle pump is attached to its upper end; by means of this the stomach may be inflated to any desired extent, while at the same time the degree of inflation is under control and can be stopped or diminished at will.

The value of inflation of the stomach is that it enables the surgeon to distend the organ until its outline can be easily appreciated; in the case of an hour-glass contraction, for instance, the result may be very striking. Inflation also enables the stomach to be percussed with accuracy, and often brings a previously unnoticeable tumour of the stomach wall well up to the surface. It is however quite a secondary method of examination and is seldom employed at the present time.

PALPATION.

A number of useful data may often be ascertained by palpation. In order to get the best results, the patient should lie upon the back on a hard couch, with the legs drawn up and the head and shoulders raised on a pillow. This relaxes the abdominal muscles and allows the hand to be pushed well into the epigastrium, while the stomach gravitates downwards unless it is fixed. It is well to have the patient almost in a sitting position before finishing the examination, as this allows the stomach to fall away from beneath the ribs. While the palpation is being carried out the patient is instructed to relax the muscles, to keep the mouth wide open, and to breathe deeply and regularly; if the hand be kept steadily pressed upon the abdominal wall in the hypogastric region, it will be found that it will pass a little deeper on each deep expiration, until ultimately the posterior wall of the abdomen can be felt. The hand should be laid flat on the surface of the abdominal wall, and violent or irregular pressure—such as that made by digging the tips of the fingers into the

skin—should be avoided, otherwise contractions of the abdominal muscles may be set up and the object of the examination defeated. Palpation should always be undertaken without anæsthesia in the first instance in order to determine the question of pain, but when the abdominal walls are rigid or the patient is stout, or when there is much pain, it may be necessary to administer an anæsthetic before completing the examination, so as to obtain satisfactory relaxation.

Before concluding the examination by palpation, the patient should be turned first upon one side and then upon the other, and, when the examination is not under anæsthesia and there is no risk in the procedure, he may finally rest upon the hands and knees so as to allow the stomach to fall forward.

In this way tumours may be felt in the stomach walls or about the pylorus, and their size, consistence, and mobility noted. Powerful peristaltic movements passing from left to right, such as occur when there is obstruction to the pylorus, may also be appreciated. Succussion may be elicited in cases of dilatation of the stomach, and the undue sensibility of the organ so frequently associated with gastric ulcer may be very evident.

PERCUSSION AND AUSCULTATION.

These methods are useful when employed in addition to others, but are not to be relied upon by themselves. The note elicited by percussion of the stomach, although fairly characteristic, is not absolutely reliable. Percussion is most valuable when it is combined with inflation (*vide supra*). Auscultation is chiefly of value in cases of hour-glass contraction, when the characteristic rushing noise due to the passage of contents from one portion of the stomach to the other through the narrow communication may be heard. In order to make out the limits of the stomach when it is not much dilated, the patient may be made to stand up and the limits of the stomach ascertained by percussion as far as possible. If now the supposed area of the stomach be marked out on the skin with an aniline pencil, its accuracy can be more or less checked by making the patient drink a pint or more of fluid and again percussing the stomach; this will then give a dull area corresponding to the greater curvature. The chief difficulty is the resonance of the transverse colon, the percussion note of which may be mistaken for that of the stomach. It has been proposed to get rid of this fallacy by means of a large water enema introduced into the rectum so as to distend the descending and transverse colon, but the method is not accurate enough to allow any reliable conclusions to be drawn from it.

EXAMINATION OF THE STOMACH CONTENTS.

This is a method of great value, and often yields most important information. It is unattended with danger, and is not therefore contra-indicated even in cases of ulceration or growth.

The essence of the method is to administer a 'test meal' consisting of certain quantities of particular foods; samples of the gastric contents are then removed by means of a soft, red rubber stomach tube during digestion at stated times after the ingestion of the meal and submitted to analysis. We are indebted to Dr. W. D'Este Emery, Pathologist to King's College Hospital, for the following account of the technique employed and the inferences that may be drawn from the results.

EXAMINATION OF THE CONTENTS OF THE STOMACH AFTER A 'TEST-MEAL.'

This method of diagnosis has been formerly practised largely—especially in America and on the Continent—and numerous procedures, some of which are highly complicated, have been introduced. These may have been successful in the hands of their inventors, but have not come into general use, and it is probable that most of the information which is of real value to the surgeon can be obtained by the simpler methods which alone will be mentioned here. Much of the information which was formerly obtained in an indirect and uncertain way by the examination of the 'test-meal' is now more easily and certainly acquired by the use of the X-rays after a bismuth meal. This is especially the case with regard to the motor functions of the stomach, which will therefore not be mentioned here.

The test-meal should be given on an empty stomach, so that the material obtained for examination may not be mixed with the partially digested remains of a previous meal. In most cases it will be sufficient for the patient to take the test-breakfast fasting, in the early morning. But if there is any evidence of dilatation it is advisable to wash out the stomach with warm water the last thing the previous night until the washings come away clear.

Numerous test-meals have been proposed, but the simple form advocated by Ewald is probably as good as any and is generally used. It consists of a slice (about two ounces) of bread or dry toast and about half a pint of water or of weak tea without milk or sugar: milk and butter should be especially avoided, as they may contain organic acids which would complicate the chemical analysis of the material after digestion.

The patient should be instructed to swallow as little saliva as possible whilst the test-meal remains in his stomach. After one hour it is to be removed, using a soft india-rubber tube, which should have two bevel-edged eyes. As a lubricant, pure liquid paraffin is best, as it is tasteless,

does not mix with the stomach-contents, and contains nothing which will complicate the subsequent chemical analysis. If oil or glycerine are used, they should be tested with litmus paper, and any that is strongly acid must be discarded. As a rule there is no difficulty in withdrawing the contents of the stomach when once the tube has been passed, the retching which this procedure usually induces in those not familiar with its passage being sufficient to expel the partially digested material. If this is not the case, the patient should be made to lie face downward with the end of the tube on the floor: the escape of the fluid may also be assisted by 'milking' the free end of the tube between the finger and thumb. In no case must water be added to start the flow, as, even if a measured amount is used, this would complicate the chemical analysis to such an extent as to render it quite untrustworthy. After as much as possible of the undiluted stomach contents have been removed, it is advisable to wash out the stomach with warm water, collecting the washings. A comparison of the total acidity of these with that of the undiluted contents will allow the total volume of the material in the stomach to be calculated with some accuracy.

In health this volume should be from 1½ to 2 ounces, and any decided increase beyond the latter figure indicates some degree of dilatation. When this condition is severe the amount removed after an hour's digestion may be almost or quite as great as the amount taken. In such cases sarcinæ will usually be present in considerable numbers.

The examination of the material removed must be both microscopical and chemical. The material should be filtered, and the former examination carried out on the material which remains on the filter-paper, the filtrate being reserved for the chemical analysis.

Microscopical examination.—A small amount of the solid residue should be examined wet, between slide and cover-glass. The bulk of the material present will be found to consist of partially digested food (mainly starch). In health, but few organisms are seen; the amount of hydrochloric acid present in normal gastric juice being sufficient to inhibit growth. Sarcinæ are characteristic of dilatation of the stomach, in which condition they occur in large numbers. They are readily recognised in unstained preparations as refractile masses consisting of agglomerations of cocci pressed together so as to have a roughly cuboidal shape: the old comparison of the resulting mass to a bale of wool is a good one. Sarcinæ are rarely found in large numbers in carcinoma of the stomach. Yeasts are frequently found in a variety of diseases, and appear to be able to grow in a larger percentage of hydrochloric acid than can most other micro-organisms. The Boas-Oppler bacillus is a form of lactic acid bacillus which is frequently found in cancer of the stomach, and is comparatively rare in other conditions: its presence in large numbers has, therefore, a considerable amount of diagnostic value. It is a rather large bacillus with parallel sides, and is grouped in long chains, the

individual elements of which are so closely united that the whole appears to be one long thread. It is usually non-motile, but occasionally seems to possess a slow crawling motility. The long threads have frequently a characteristic angle at some portion of their length, from which feature the organism is sometimes termed *B. geniculatus*.

The solid residue should also be examined for pus, blood, and, most important of all, fragments of growth. For the latter examination the material left on the filter-paper may be diluted with water or normal saline solution and spread out in a thin layer in a Petri dish on a piece of black paper. Suspicious fragments should be examined under a low power of the microscope, and if they appear to consist of animal tissue the wisest course is to embed them in paraffin and cut sections. In this way conclusive evidence of the presence and nature of cancer of the stomach is occasionally forthcoming.

Chemical examination.—This is to be carried out in the filtrate, and the most important point is the determination of the presence or absence of free or physiologically free hydrochloric acid. The terms need a little explanation. A watery solution of hydrochloric acid contains the acid as such, and it will react to all the customary tests. If, however, some protein material, such as blood-serum or egg-albumen be added, the acid enters into a state of loose chemical combination therewith, and fails to react to some of the tests. Such acid is physiologically free: it is available for peptic digestion, and it must be estimated when the amount of acid secreted by the stomach is to be determined. The only method by which this can be accomplished with exactness is Volhard's or one of its modifications. Two equal portions of filtrate are evaporated to dryness and incinerated—the one as it is and the other after addition of soda. The free and physiologically free acid is driven off from the former, whereas in the latter it combines with the soda to form sodium chloride. The amount of chlorine in each residue is now estimated, and the difference gives the amount of chlorine occurring as active hydrochloric acid in the amount of filtrate examined. This test is chemically sound, but is tedious; it requires more fluid than is usually available, and in practice it is usually replaced by titration with a standard (decinormal) alkali, making use of certain indicators which only react, or are most sensitive to, free inorganic acids. Of these tests the most important are Töpfer's and Günzberg's.

1. Töpfer's test consists of a 2 per cent. alcoholic solution of dimethyl-amidoazobenzol, which turns bright crimson in presence of inorganic acids. The reaction may be given if large amounts of free organic acids are present, and it may be masked by a great excess of protein material, but as applied to the filtrate obtained from a test-meal it is fairly trustworthy.

2. Günzberg's test consists of phloroglucin two parts, vanillin one part, alcohol thirty parts. It should be prepared fresh. For the test a few

drops are evaporated to dryness on a porcelain dish by gentle heat, a drop of the filtrate added, and the dish again warmed; care must be taken to avoid charring. A rose-red colour is given when free inorganic acids are present.

The simplest way to proceed is as follows: Take 10 c.c. of the filtrate and add a couple of drops of a 1 per cent. alcoholic solution of phenolphthalein. This is the indicator for the determination of the total acidity; it is colourless in presence of acids, whether organic or mineral; pink in alkaline solutions. Add also a few drops of the solution of dimethylamidoazobenzol. If free, or physiologically free hydrochloric acid be present, the solution will turn pink. Now run in decinormal caustic soda from a burette until this pink colour is just discharged. Note the amount: it indicates the amount of standard solution necessary to neutralise the active hydrochloric acid. Continue the addition until the solution again becomes pink; the amount of soda solution will give the total acidity. Instead of adding the dimethylamidoazobenzol to the fluid, I prefer to remove a drop of the latter after each addition of standard soda, and test it by mixing it with a drop of the indicator on a porcelain slab. When a pink colour is no longer given the active hydrochloric acid is neutralised.

The calculation is simple. Each cubic centimetre of the decinormal soda solution contains 0·004 NaOH and is neutralised by 0·00365 HCl. Then if we took 10 c.c. of the filtrate and added 3 c.c. of decinormal soda before the disappearance of the pink colour with dimethylamidoazobenzol, the percentage of active acid was $3 \times 0{\cdot}00365 \times 10$, or 0·1095 per cent. If the total amount added before the phenolphthalein turned pink was 4·5 the total acidity was $4{\cdot}5 \times 0{\cdot}00365 \times 10$, or 0·16425 per cent. The difference (0·05475) indicates organic acids and acid salts; the latter are practically constant if the same test-meal is given, and a large difference between the free and the total acidity indicates the presence of organic acids, which must now be sought for. The presence of organic acids may be demonstrated by the use of Congo red paper, which turns blackish-blue, the colour disappearing when the paper is warmed over a spirit lamp, whereas that due to hydrochloric acid remains.

The only important organic acid met with after a test-meal is lactic; when present in large amount it indicates that much fermentation is going on, and is presumptive evidence in favour of carcinoma. It is rarely if ever present in large amount, when more than a trace of free hydrochloric acid is present, and it is unnecessary to search for it in these conditions; a minute amount may be derived from the bread taken, and much larger quantities may occur if milk or butter has been ingested. The best test is Uffelmann's. To half a test-tube of 1 in 40 carbolic acid add one drop of liquor ferri perchloridi; to the deep violet solution thus obtained add the solution to be tested. Lactic acid gives a fine canary-

yellow colour. Other substances may decolorise the solution or give a dirty yellowish-brown colour. If the test has to be applied to vomit or other complex mixtures it is necessary to shake out the lactic acid with ether, evaporate to dryness, and redissolve the residue in water, but this is hardly necessary after a simple test-meal.

Admixture with bile, which is alkaline, will render any examination of the test-meal for acids quite untrustworthy. It may occur if the retching occasioned by the introduction of the tube has been severe.

In health the amount of active hydrochloric acid in the stomach contents is usually 0·2 per cent. or more. In most cases of gastric carcinoma the amount is usually greatly reduced, and in many it is absent altogether. Occasionally, but rarely, the amount may be normal or even slightly increased, but in general terms the presence of 0·1 per cent. may be taken as good evidence against malignant disease. It is also reduced in chronic gastritis and in 'functional' achlorhydria. The amount is usually increased in cases of gastric ulcer and in 'functional' hyperchlorhydria. In these functional conditions the actual change is probably in the amount of gastric juice secreted rather than in the percentage of acid it contains; undiluted gastric juice contains some 0·4 per cent. of free acid.

The presence of blood is of some importance. It cannot usually be recognised microscopically, being altered by the free acid present. Place some of the sediment on a slide, add a drop of glacial acetic acid and a minute crystal of salt, apply a cover-glass, and warm until bubbles commence to form; on cooling, search the specimen for the characteristic crystals of hæmin. Or apply the benzidine test for occult blood thus: Boil some of the sediment in a little water, cool, and filter. Prepare a saturated solution of benzidine in glacial acetic acid by shaking about half a teaspoonful of the crystals with an inch or two of the acid in a test-tube. Add some of the clear solution to the filtrate (approximately equal parts), and to the mixture add peroxide of hydrogen, a drop at a time; a fine blue or bluish-green colour will indicate the presence of blood. It is advisable to try a blank test without the addition of filtrate in order to be sure of the purity of the reagents, and to use new test-tubes, as the reaction is extremely delicate. The same test may be used for occult blood in the fæces (which is often present in carcinoma of the stomach, as well, of course, as in ulcer), but here it is necessary that the patient should not have eaten red meat, etc., for a few days previously, or the amount of hæmoglobin thus ingested may be sufficient to give the reaction.

GASTRIC LAVAGE.

This may be employed for the removal of the contents of the stomach for examination and analysis. The lavage should always be done by syphoning off the contents and never by withdrawing them by means of

a syringe. A soft, red rubber œsophageal tube (known as Jaques') about thirty inches long is connected by an inch of glass tubing with a length of india-rubber tubing, at the other end of which is a glass funnel capable of holding from half a pint to a pint. The tube—which should have both a lateral and a terminal opening, so that if one gets blocked the other may act—is passed in the same manner as an œsophageal bougie (see p. 174), being assisted by swallowing efforts on the part of the patient. When it is in position, the patient's head is bent well forwards or turned to one side so as to allow the saliva to flow out of the mouth, and the funnel is held at or below the level of the stomach.

As a rule the gastric contents begin to run into the funnel immediately the end of the tube passes into the stomach, and may be collected for analysis. If the fluid does not run immediately, the funnel should be lowered well below the level of the stomach and the patient asked to cough or strain. Should this manœuvre fail, it is only necessary to fill the funnel with a little warm water and to raise it above the level of the mouth; when some of the contents of the tube have thus been made to enter the stomach, the funnel is lowered and the fluid syphoned off. As much of the gastric contents as possible is run off first and then the irrigation is proceeded with. The funnel is filled with either saline solution or boiled water at the body temperature, and by raising it to the level of the mouth when the patient is in the sitting position or slightly higher when he is recumbent, this is allowed to enter the stomach gradually. Before the funnel is quite empty, it is again lowered below the level of the stomach and as much fluid as will run away is withdrawn. This process is repeated several times until the fluid returns quite clear, and is a better plan than that of first filling the stomach with a large quantity of fluid and then allowing it all to run away. If one funnel-full at a time is introduced and withdrawn there is no risk of over-distending the stomach, and the procedure is painless.

There are no real difficulties or dangers attaching to this method. It should not however be carried out in bad heart-disease or great cachexia from constitutional mischief, as the nervous disturbance caused by it might be prejudicial. It should not be used in cases of gastric ulcer or gastric cancer with active bleeding. In other cases, however, both of ulcer and cancer, it is unobjectionable.

Gastric lavage is also employed as a method of treatment, and this will be referred to again; it is not curative, but it renders the patient much more comfortable by withdrawing fermenting contents from a stomach that is unable to pass them on, and thus diminishes the distension. It is also an exceedingly valuable preliminary to abdominal operations.

Transillumination of the stomach has also been employed, a sound bearing a powerful electric lamp at its end being passed into the viscus, which may or may not be artificially distended (see p. 229). The object of the procedure is to give a view of any shadow produced by growths or

localised thickenings, and also to give some idea of the extent of the cavity; it is not a reliable method.

Attempts have been made to inspect the interior of the stomach from the mouth by means of an instrument similar to the cystoscope. This method, known as **gastroscopy,** requires special apparatus, is difficult to carry out, and is of such small value that it is hardly worth noticing. In most of the cases in which such a method would give results of value the diagnosis can be made readily by simpler means. Quite recently an improved form of gastroscope, modelled largely upon the cystoscope, has been introduced by Rovsing. It is used as an adjunct to an exploratory laparotomy and is passed through a small incision in the wall of the stomach. The cavity of the stomach is distended and examined by transillumination, or the mucous membrane can be examined visually (*Annals of Surgery*, Sept. 1912).

A certain amount of information may be obtained by means of the **X-rays.** Tumours of the stomach may sometimes be detected by their shadow; foreign bodies of a metallic nature, such as pins or coins, that have been swallowed can be readily distinguished and located. The stomach area may also be mapped out with some amount of accuracy by the rays after the administration of substances which are opaque to them. For instance, the patient is made to swallow a thick emulsion of the oxychloride of bismuth, which is diffused evenly over the stomach and casts a shadow with the rays; any encroachment upon or irregularity of the normal gastric area can be seen on the fluorescent screen, or by means of radiograms. This salt of bismuth is innocuous, and at most a gentle laxative is required for its complete evacuation.

It is obvious, however, that all these methods are open to so many fallacies that they cannot be looked upon as more than mere accessory methods in difficult cases, and further, that none which involve the passage of an instrument are permissible if there is any suspicion of ulcer or even of an actively ulcerating growth, and thus their applicability is still further limited.

EXPLORATORY LAPAROTOMY.

This is the most valuable method of all, and in some cases it may be indispensable for an accurate diagnosis. In addition, it has the advantage that it may be the first step in the treatment. The advisability of doing an exploratory laparotomy in a surgical affection of the stomach must, however, be carefully weighed. If it be evident from external examination and a consideration of the various symptoms that no remedial measure is possible, then exploratory laparotomy is not justifiable, even though the surgeon may not know the exact site and nature of the disease, as it would merely be indulging curiosity. Before he decides upon an exploratory operation, the surgeon must feel satisfied that the

condition is one in which there is a probability that the exploration will lead to the immediate adoption of some remedial treatment; if there is any uncertainty as to the feasibility of remedial measures, the surgeon must feel confident that the procedure will not be dangerous in itself.

Typical examples of the utility of exploratory operations are the following: When there is a tumour in the neighbourhood of the pylorus which is freely movable and accompanied by symptoms of dilated stomach, an early exploration should be carried out, because the enlargement may be inflammatory, and an exploratory operation will enable the surgeon to proceed to pylorectomy or gastro-jejunostomy which will probably cure the patient. Should the swelling turn out to be a malignant tumour, the exploration will show whether excision of the pylorus is advisable and, if not, the patient's condition may be improved by a gastro-jejunostomy. Again, exploration is often of benefit in obstinate cases of pain and dyspeptic symptoms, as it may reveal the presence of adhesions or bands, or of trouble in some other organ, such as the appendix or the gall-bladder, the removal of which will relieve the symptoms. Or again, it may reveal the presence of an ulcer or cicatricial contraction as the result of an ulcer, and these adhesions and contractions may be suitably treated. On the other hand, to perform an exploratory operation on a patient who evidently has extensive cancer of the stomach, and on whom there is very little chance of performing gastro-jejunostomy and relieving the symptoms, or on one who is obviously not in a fit condition for any severe operation, such as excision of the pylorus, is merely satisfying idle curiosity. At the present day there is too great a tendency to the employment of an exploratory laparotomy to the exclusion of other methods of diagnosis.

It has happened somewhat unfortunately that large irremovable tumours have been met with when the abdomen has been opened, and improvement, or even apparently a complete cure, has followed the operation. This has undoubtedly given a fillip to exploratory laparotomy even in hopeless cases, under the impression that the tumour might disappear as a result of the laparotomy. It is probable that these tumours are not malignant. We know that in the case of the stomach, an extensive fibromatosis of the organ is not infrequently met with (see p. 253) which is indistinguishable, macroscopically, from carcinoma. To cut into an abdomen containing a typical cancerous tumour on the chance of the laparotomy leading to the disappearance of the tumour is a practice that cannot be too strongly deprecated. But whenever the symptoms point to some condition that is remediable, or when there is doubt as to the applicability of several methods of treatment, an exact diagnosis is imperative and an exploratory laparotomy should be done. No exploration should be practised, however, even in these cases, unless the surgeon is prepared to carry out forthwith any method of treatment that seems most suitable.

CHAPTER XVI.

INJURIES OF THE STOMACH: FOREIGN BODIES.

INJURIES.

INJURIES of the stomach may be caused by blows, crushes, stabs, or bullet wounds, and vary widely in their results. Contusions of the stomach give rise to lesions varying from superficial bruising to damage severe enough to end in local gangrene. The stomach may also be ruptured partially or completely, the rupture being more likely to occur when the viscus is distended than when it is empty. In the less severe cases there is a simple contusion of the stomach wall; in the more severe, one of the coats of the viscus—usually the peritoneal covering—may be ruptured, or there may be a complete rupture of the stomach wall with extravasation of its contents.

In the case of stabs and gunshot wounds, there is usually perforation of the stomach wall. These perforations vary from mere punctures—such as those produced by high velocity bullets—to clean-cut or contused wounds. They are most common on the lesser curvature near the pylorus.

When the stomach has been ruptured and the opening is large, the contents escape freely into the abdominal cavity; when, however, the opening is small this may not occur, for the mucous membrane may prolapse through the opening and occlude a small wound sufficiently to prevent immediate escape of the gastric contents, especially if the organ be empty at the time of the injury. If this prolapse is slight, localised peritonitis will occur around the opening which may thus become adherent to any structure situated in its immediate neighbourhood; in this case the connection between the abdominal cavity and the interior of the organ may be rapidly shut off and the patient may recover.

These injuries may be grouped under two headings:—

1. *Non-perforating wounds*, in which the mucous membrane of the

viscus is uninjured, and which vary from a simple contusion to partial rupture of the coats of the stomach; these are usually accompanied by non-perforating injuries of the abdominal wall, such as simple contusions, but occasionally a non-perforating wound of the stomach may occur in connection with a perforating one of the abdominal wall when the injury is done with a blunt instrument, the chief force being expended in driving the instrument through the muscles.

2. *Perforating wounds*, in which the interior of the stomach communicates with the general peritoneal cavity; these again may be subdivided into (*a*) injuries accompanied by perforating wounds of the abdominal wall and (*b*) those occurring independently of this condition. The injuries are not necessarily limited to the stomach itself; in gunshot or sword wounds, for instance, the pancreas, liver, or spleen is frequently injured at the same time.

Symptoms of non-perforating injuries of the stomach and abdominal wall.—It is often extremely difficult to separate the symptoms due to the injury to the abdominal wall from those due to the injury to the stomach. Hæmatemesis and melæna may be present, but they do not indicate the exact nature of the lesion in the stomach. When the patient receives a blow in the region of the stomach there is great shock from the blow on the solar plexus, and if this is prolonged and the pain becomes more intense and the vomiting persists, a severe contusion of the stomach is probable. These symptoms will pass off in the course of three or four days unless the injury is so severe as to lead to local gangrene, when they will persist and will be followed at the end of a week or ten days by those of sudden perforation or of a spreading peritonitis.

Symptoms of perforating wounds of the stomach unaccompanied by a perforating wound of the abdominal wall.—In some of these cases the diagnosis is simple, in others it is extremely difficult. Should there be free communication between the stomach and the abdominal cavity, gas will find its way into the peritoneum; this very important symptom shows itself by distinct decrease of the liver dullness, although the abdomen is not distended. There is also extreme collapse, a rapid pulse, a peculiarly anxious countenance, and rigidity of the abdominal muscles. The temperature is subnormal, the breathing is entirely thoracic, and the skin is cold; there is frequently hæmatemesis.

When, however, the rupture of the stomach is small, is situated on the posterior surface, or takes place during fasting, the symptoms may be slight until acute peritonitis sets in. An important help in arriving at a correct estimation of the state of affairs is the condition of the stomach at the time of injury; suspicion of rupture will be aroused if the accident has occurred after a full meal, and especially if there is also blood-stained vomiting, marked thoracic breathing, and an amount of collapse out of

all proportion to the severity of the injury. If this condition continues and if the pulse becomes rapid and the abdomen distended as well as tender, the suspicion will become almost a certainty. Later on the pain is greatly increased, and persistent vomiting occurs as peritonitis sets in. *When there is any doubt, it is much wiser to make a small incision in the epigastrium to ascertain the exact condition of affairs than to watch the patient until the diagnosis is certain; by that time the peritonitis which follows these accidents will have become too extensive to be successfully treated.*

In order to overcome this difficulty in diagnosis, it has been suggested to inflate the stomach, and so to ascertain whether air passes freely into the abdominal cavity. This, however, is an extremely dangerous plan unless practised after the abdomen has been opened, as it is apt to force out the contents of the stomach into the peritoneal cavity and may do an infinity of harm.

It sometimes happens that these abdominal injuries are accompanied by laceration of some of the large vessels in the greater curvature or the omentum. This question is discussed in connection with injuries of the intestine (see Chap. XXI.).

Symptoms of perforating wounds of the stomach accompanied by a perforating wound of the abdominal wall.—Here there is less likelihood of making a mistake in the diagnosis since there is already a wound in the abdominal wall, and the only point to settle is whether there is also a perforation of the stomach. Any suspicion, such as would be aroused by the symptoms detailed above, can easily be verified by enlarging the abdominal wound, when the condition will be evident at once. The proper examination and treatment of the wound in the abdominal wall necessitates an anæsthetic in any case, and very little more manipulation is necessary in order to settle the diagnosis.

TREATMENT.—1. Of doubtful rupture of the stomach accompanied by a contusion of the abdominal wall.—When there is no wound in the abdominal wall and the symptoms do not clearly indicate perforation, the surgeon is justified in waiting for a few hours to see the course of events. The patient should be put to bed surrounded by hot bottles and warmly covered so as to diminish shock. The knees are flexed over a pillow and the thorax slightly raised so as to relax the abdominal muscles. A large flat ice-bag (see Fig. 88) applied to the epigastric region may help to control the vomiting if this is severe. Nothing should be given by the mouth, but a hot enema containing beef tea, brandy, and half an ounce of strong coffee should be administered. Liquor strychninæ (ℳv) may be injected hypodermically if the shock is profound, but morphine should not be given until it has been decided whether there is rupture of the stomach or not. Should no perforation have occurred, the symptoms will subside gradually, and the patient will be well in a week. It should always be remembered that the stomach is not the only organ that may be injured by blows upon

the epigastrium ; the first part of the duodenum, the pancreas, the liver, the gall-bladder, or the spleen, may suffer, and the surgeon's attention should not be directed solely to the condition of the stomach.

2. Of rupture of the stomach without perforation of the abdominal wall.—An exploratory laparotomy should be done immediately in all cases of contusion of the abdomen in which the symptoms appear to point to rupture of the stomach, and after a few hours in cases in which a contusion of the abdominal wall is accompanied by doubtful symptoms of stomach injury which steadily increase in severity. If the collapse in the latter cases shows no signs of improvement under treatment in the course of two or three hours, while the abdominal rigidity increases—and in any case in which there are signs of gas free in the abdomen—no further delay is permissible and the abdomen should be opened in the middle line ; even if no injury is found, the patient will be little the worse for the exploration, while it may be the means of saving life if the stomach has been ruptured.

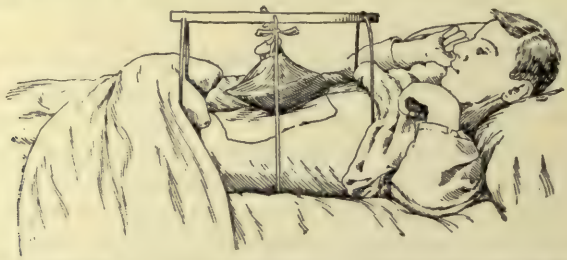

FIG. 88.—METHOD OF APPLYING AN ICE-BAG. A large flat ice-bag is slung from a cradle and rests upon a double fold of lint placed next the skin.

Should no perforation of the stomach be found and should there be no intraperitoneal hæmorrhage or rupture of the liver or spleen, the duodenum should be examined before the abdominal wound is closed. The condition of the posterior wall of the stomach should always be ascertained as well as that of the anterior, as injuries may occur in this situation from severe blows on the epigastrium without any wound of the anterior wall.

Operation.—The most energetic *measures must be taken against shock*, and rapidity of operation and a warm room are especially important.

The incision should be a vertical one, about an inch to the left of the middle line, reaching from the xiphoid cartilage to the umbilicus. As a rule, blood and gas will be apparent immediately the peritoneum is opened if the stomach has been ruptured. If a rupture is found, the treatment has two main objects—the first, to prevent further extravasation and to repair the rent in the wall of the stomach, and the second, to remove the extravasated contents from the abdominal cavity. As a rule it is best to begin with the repair of the wound in the stomach wall.

Repair of the injury to the stomach.—The stomach is brought well out through the abdominal wound, the edges of the rupture are seized with catch forceps and pulled well up, and the injured area is isolated from the rest of the peritoneal cavity by packing sterilised abdominal cloths around and beneath it so as to prevent further gastric contents finding their way into the abdominal cavity. It is well to mop out the remaining contents of the stomach and inspect its interior in order to make sure that no wound has occurred elsewhere in the organ ; if necessary the wound in the stomach should be enlarged for this purpose. Any torn edges and projecting

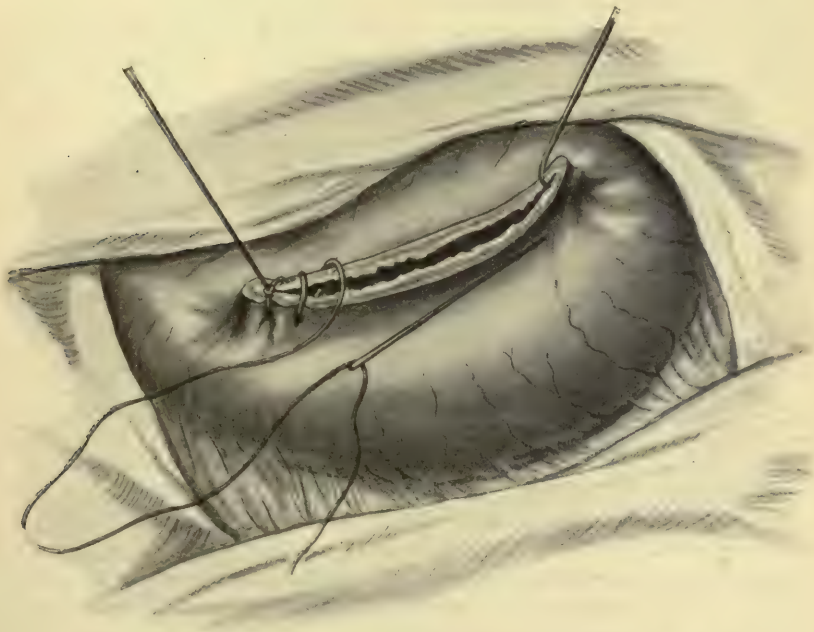

FIG. 89.—SUTURE OF A WOUND OF THE STOMACH WALL.—The ends of the wound are put on the stretch by traction, and are also raised well above the surrounding area. It is thus easy to suture the wound without the stomach contents escaping.

tags of mucous membrane are then clipped away and the sides of the rent sewn together by a continuous through-and-through suture of catgut taking up all the coats of the stomach. A blunt hook placed at each end of the cut will prevent the line being puckered up as the suture is tightened and will also prevent the escape of the stomach contents (see Fig. 89), but if there is not sufficient assistance, the cut edges can be seized in a clamp and through-and-through sutures passed around it and tightened up as the clamp is withdrawn. This deep suture checks the bleeding from the cut surfaces and is buried by a continuous Lembert's suture of finer catgut, taking up only the serous and muscular

coats on each side and commencing about a sixth of an inch external to the deeper one and extending a good half inch beyond it at each extremity.

When the rent in the stomach wall has been repaired, the surgeon turns his attention to the important task of dealing with the extravasated gastric contents. In all cases the edges of the abdominal incision are retracted as widely as possibly—which may be done most easily by some form of dilating retractor, such as that shown in Fig. 90, and the necessary steps are taken with the least possible interference with or movement of the intestinal coils. This is of great importance, as disturbance of the coils is a sure way of disseminating the extravasated material more widely.

The treatment of the abdominal cavity is a matter of the greatest moment, as the recovery of the patient depends almost entirely upon whether it is efficient. From the point of view of operative interference, it is well to divide the cases into three groups : namely—(1) those

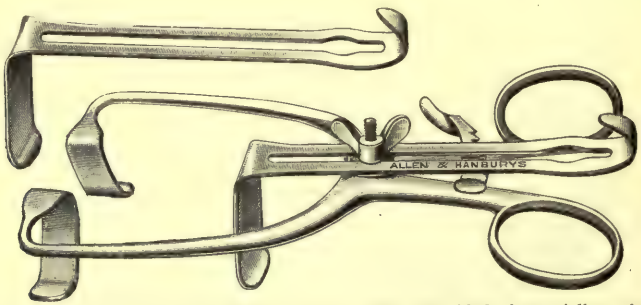

Fig. 90.—Pozzi's Abdominal Retractor. The extra blade is specially useful when a special area of the abdomen has to be isolated, as in gall-bladder or uterine operations. The retractor is self-retaining, and is made so that its blades open very widely. It is very useful when the surgeon is short-handed. The handles are directed downwards towards the pubes.

in which the extravasation is small and limited to the area of the injury in the stomach ; (2) those in which the extravasation is spread over a wide area of the abdomen, but is fluid in character ; and (3) those in which the fluid is not only extensively diffused, but contains many coarse particles—such as portions of meat or vegetables.

(1) *Should the escape of gastric contents be quite small,* so that only the immediate neighbourhood of the rent is soiled—as is frequently the case when the opening is small and the stomach empty—the extravasated material should be mopped up systematically and thoroughly with swabs or fine sponges. This should be done extremely carefully, and no rough handling is permissible ; unduly vigorous manipulation defeats its own ends, as it damages the epithelial lining of the peritoneum, and may actually rub infective material into it. The surface should be lightly touched rather than roughly sponged. All recesses should be gently opened up in order to facilitate this cleansing, but nothing like wide-spread separation of coils of intestine should be practised, nor should

the abdominal cavity be irrigated, as the fluid might disseminate the extravasated material into situations from which it could not be easily removed.

(2) *When the peritoneal cavity has become extensively soiled by the contents of the stomach and when these are fluid*, it is obviously impossible to remove the material by mopping within reasonable time or without serious mechanical injury to the peritoneum, and therefore recourse must be had to *irrigation*. The abdominal incision should be enlarged so as to get complete and easy access to all parts of the abdomen, and irrigation is performed with normal saline solution which should be used in large quantities at a temperature of 105° F., tested by the thermometer, and not merely by the sense of touch.

It is a useful precaution also to mop out the flanks, Douglas's pouch, and the interval between the stomach and the liver before proceeding to employ irrigation ; this should be done, not as is frequently the case, by mounting the sponges upon sponge-holders and thrusting them down amongst the intestines in the desired direction, and then rotating and withdrawing them, but by separating the intestines with one hand, and mopping out the area by sponges held in the other. It is quite useless to expect satisfactory cleansing of the peritoneal cavity by simply plunging sponges in amongst the intestines. Not only do they scrape the peritoneum as they pass to their destination, but the materials taken up on the sponge become wiped off against the intestinal coils as they are withdrawn, and the whole procedure is rendered futile. The area immediately adjacent to the rent should first be gently and rapidly cleaned up (*vide supra*) ; the stomach, the transverse colon, and the omentum are then similarly treated, after which they are raised, the transverse mesocolon is separated from the rest of the intestines and the space beneath it cleansed. The intestines are next displaced from one flank by an assistant and the surgeon mops up that area carefully and systematically, after which a like procedure is carried out on the other side, and finally in Douglas's pouch. Lastly, as many of the coils as may be necessary are separated from each other and held apart and the same treatment adopted here. The operation is completed by flushing out the abdomen.

If an irrigating apparatus is at hand, it should be employed ; failing this, the fluid may be poured into the abdominal cavity from a jug. The assistant raises and holds apart the cut edges of the opening so as to make the abdominal cavity contain as much fluid as possible, and a stream of the saline solution is then projected into it with some force. When the abdomen is full, the hand introduced amongst the intestines separates them in various directions so as to facilitate the access of the fluid. There are certain situations to which particular attention must be directed, and while the stream of solution is directed upon them with one hand, the coils of intestines are separated with the other, so as to open up all recesses and to enable any particles to be mechanically dislodged and

carried away. The chief of these recesses are the space between the stomach and the liver, the flank on either side, and Douglas's pouch, as in these directions the more solid particles will gravitate and lodge. The irrigation should be continued until the fluid runs out clear. The assistant then lets go the edges of the incision and the bulk of the fluid escapes from the abdomen.

(3) *Should there be very extensive rupture of the stomach so that the whole of the peritoneal cavity is soiled, and should the extravasated material contain coarse particles of food which are widely distributed over the peritoneal cavity,* it will be necessary to carry out the cleansing of the abdomen more thoroughly. For this purpose the abdominal incision must be enlarged, so that it reaches almost from the xiphoid cartilage to the pubes, and the intestines must be turned out of the abdominal cavity on to hot cloths spread on the abdomen to receive them. This empties the abdominal cavity, which can then be mopped up and flushed out extremely rapidly, Douglas's pouch and the lumbar region being thus rendered perfectly accessible. The coils of intestine should then be spread out upon the cloths on the front of the abdomen and examined coil by coil as quickly as possible, being flushed with hot normal saline solution (105° F.) under fair pressure from the nozzle of an irrigator as this is done. All foreign material is thus removed and solid particles are caught upon the abdominal cloths as they are washed off the intestines and are thus not likely to infect other portions of the peritoneum. The whole operation of *evisceration* must be done rapidly, and it is well at the same time to inject saline solution into each axilla unless the intravenous method of inducing anæsthesia (see p. 32) is being used. If the surgeon is alarmed at the severity of the collapse previous to the operation and hurries unduly over the cleansing of the abdomen or performs it in a perfunctory manner, he will lose patients who might otherwise be saved by a more thorough and deliberate procedure. There can be no doubt that this method of evisceration adds to the shock ; but against this must be placed the facts that these patients are otherwise certain to die of peritonitis in a day or two and that this method offers them practically the only chance.

We do not wish to imply that evisceration should be practised in all cases of widespread infection of the general peritoneal cavity. When the material in the peritoneal cavity is fluid and does not contain large solid lumps and masses, the procedures already detailed (*vide supra*) will probably do all that is required and certainly with less shock. When, however, solid masses of potato, meat, or other material, are widely distributed over the abdomen and are not likely to escape with the fluid employed for flushing, the more thorough method of cleansing by evisceration must be employed.

Closure of the abdominal wound.—The abdomen is closed in the usual way, through-and-through stitches and not buried ones being employed (see p. 219) ; but before doing this, the question will arise as to whether

drainage should be employed. Experience has shown that many cases do extremely well without any drainage whatever, and if the surgeon is fairly sure of having removed all the infective material, especially if the area of extravasation has been small, the abdominal cavity may be safely closed without drainage. On the other hand, when there is any doubt, it is well to introduce drainage tubes down to the neighbourhood of the so-called ' gravitation areas '—namely, the two flanks and the true pelvis. For this purpose small ' stab wounds ' may be made just below the twelfth rib on each side by thrusting a long pair of forceps through the soft tissues just external to the kidney from the inside and making their points project beneath the skin, where they are cut down upon. The blades are pushed through the opening and separated so as to dilate the track ; a medium-sized drainage tube is then seized by the forceps and pulled into position as they are withdrawn. A similar incision is made through the anterior abdominal wall just above the pubes, and a large-sized rubber tube is inserted down to the bottom of Douglas's pouch. The tubes are cut off flush with the skin and sutured in position. Their function is to drain off any fluid which has escaped removal and which gravitates into the dependent pockets in which they lie. As they very soon become shut off from the general peritoneal cavity, their action is only local after a few hours. The after-treatment of these cases is given below.

3. Of perforating wounds of the stomach accompanied by a perforating wound of the abdominal wall.—In civil practice, where the patient is under suitable conditions, it may be laid down as a general rule that wounds of the abdominal wall over the region of the stomach, whether inflicted by knives or similar instruments or the result of a bullet wound, should always be explored at once and the condition of the stomach and intestines ascertained. An anæsthetic should be given, the abdominal wall disinfected, the wound cleansed and if necessary enlarged, and care must be taken not to allow the antiseptic to run into the interior of the abdominal cavity. When the direction of the wound renders it probable that it has reached the stomach, the question will arise whether it is better to enlarge the existing opening in order to examine that organ, or to make a fresh vertical incision in the usual situation. If the abdominal wound is over the stomach, it should be enlarged, but if it lies much to one side it is more convenient on the whole to make a fresh incision in front.

The treatment of the injury to the stomach will be similar to that for the cases already described (*vide supra*), and if the wound has been inflicted with a sharp cutting instrument, the edges should be inverted and sutured. If, however, the edges of the wound and the stomach are contused they may be pared so as to leave clean-cut surfaces. In gunshot wounds it is always advisable to excise the track of the bullet, because it is apt to become gangrenous.

The question of drainage will be determined by considerations similar

to those applying to the cases unaccompanied by a wound of the abdominal wall, and if it is considered to be necessary it should be effected in a similar manner (*vide supra*).

In the case of gunshot injuries of the abdomen in military practice it may be well to avoid operation in many cases on account of the difficulties of carrying out asepsis, but in civil practice we do not think that the old rule demanding immediate operation for all cases of suspected injury to the viscus should be departed from; the patient can be attended to at once, and everything that is needful will be at hand.

After-treatment.—An enema containing hot coffee (2 ozs.), brandy (1 oz.), beef-tea (1 oz.), and liquor strychninæ (℥x), and an injection of morphine (gr. $\frac{1}{3}$) may be given as soon as the patient is put back to bed if the shock is severe. Subcutaneous saline infusions will be required under similar circumstances, or continuous rectal proctoclysis in the less severe cases (see Vol. I. p. 115). This helps to alleviate the intense thirst from which these patients often suffer.

There is no reason to abstain from feeding the patient by the mouth as soon as the anæsthetic vomiting has ceased. The food must be fluid at first, but in a very short time semi-solids may be given, and the patient may be allowed solid food in about a week.

These patients should always be placed in the 'Fowler position' after the operation—that is to say, they should be propped almost bolt upright in bed so that all fluids may gravitate downwards to the pelvis, and the diaphragm may not be hampered. Fig. 91 shows how this position can be efficiently maintained without fatigue to the patient. In most cases they can be placed in this position at once, but if the shock is severe, the recumbent position may be necessary for some hours.

Morphine may be required for pain or restlessness during the first few days, but it should not be employed unless it is distinctly indicated, as it disorders the digestion and may cause much trouble with the bowels. For mere restlessness, as apart from pain, such drugs as aspirin (gr. x), the bromides of ammonium and potassium, and chloral hydrate are more suitable. The regulation of the bowels must be carefully attended to. It is of the first importance that flatulent distension should be avoided. After the first twenty-four hours calomel, in doses of one-quarter grain, may be administered every hour until an action has resulted or five grains have been taken. In other cases a dram of phosphate of soda every three hours acts better. The subsequent regular evacuation may be ensured by doses of cascara evacuant, infusion of senna-pods, or other mild aperients; later, liquid paraffin (℥ss.) may be given night and morning.

When the abdominal wound has been closed without drainage, no belt is required, and the patient may be allowed to get up at the end of about three weeks wearing a firm abdominal bandage, which should be

continued for about two months after the injury. When drainage has been employed, however, there will be a tendency to ventral hernia through the track of the tube. This may be prevented to a certain extent by passing sutures at the time of the operation through the abdominal wall where the tube emerges, leaving their ends long and tying them when the tube is withdrawn, so as to have as little healing by granulation as possible. When drainage has been employed, it is well to make the patient wear a broad abdominal belt with a flat pad overlapping the cicatrix in all directions; the pad must not be conical, otherwise its

FIG. 91.—THE SLING PILLOW FOR MAINTAINING THE 'FOWLER POSITION' AFTER LAPAROTOMY. By altering the length of the straps the patient can be made to sit bolt upright. (Mayo Robson, *A System of Operative Surgery*.)

pressure will weaken the scar and make a hernia certain. If a hernia forms, an operation may be done for its cure at a later date.

FOREIGN BODIES.

Foreign bodies in the stomach are very common, but the majority cause no trouble; they find their way along the alimentary canal and are passed *per rectum*. The commonest are small coins, buttons, beads, or fruit-stones. A rarer but more important group are large bodies, such as toothplates, knives, or forks, which sometimes lodge in the stomach;

in women also, especially in lunatics or extremely hysterical subjects, balls of hair, sometimes of enormous size, may form in the stomach as the result of the practice of constantly biting the ends of the hair. When a large body reaches the stomach, its escape may be difficult on account of its size or its shape. Bodies with sharp points which penetrate the stomach walls and may cause ulceration and perforation are particularly dangerous.

The presence of a foreign body of this kind is usually easily recognised. In the first place the history of the case is often quite clear; no mistake can well be made when the patient swallows a toothplate, or a public performer swallows a knife, while the history is also usually clear in the case of lunatics. In addition to this, there are the local symptoms, such as constant pain and tenderness on palpation, and sometimes there is a swelling to be felt in the stomach; in a large number of cases the X-rays will determine the existence of a foreign body and its situation.

TREATMENT.—(*a*) **Of small smooth bodies.**—For small foreign bodies, such as those usually swallowed by children, all that is necessary is to facilitate their passage along the alimentary canal. For this purpose it has long been the custom to administer tenacious substances, such as porridge, thick rice-pudding, or figs, with the object of filling up any crevices in the foreign body, and so converting it into a smooth object which can pass along the alimentary canal with the least possible amount of irritation.

(*b*) **Of large bodies.**—When the body is too large to pass through the pylorus, it will give rise to much distress, and if it should possess sharp points or edges, there is serious risk of ulceration and perforation; its removal is therefore urgently called for.

Gastrotomy.—If performed as soon as it is evident that the foreign body will not pass safely along the alimentary canal, gastrotomy is very simple and safe, whereas the risk is considerable if it is delayed until the foreign body has set up inflammatory changes in the stomach wall. An incision should be made a little to the left of the middle line, commencing on a level with the tip of the xiphoid cartilage and running vertically downwards for about four inches. The method of opening the abdomen has already been described (see p. 215). If the stomach does not present at once on incising the peritoneum and separating the edges of the abdominal wound, it will be necessary to push down the great omentum and the transverse colon, when the stomach will come into view, and there will be no difficulty in making out the position of the foreign body; the portion of the stomach containing it should be pulled out of the wound and packed off with abdominal cloths.

The next step is to open the stomach, and the best situation for this incision is on the anterior surface about midway between and parallel to the two curvatures; here the vessels are smallest and there is consequently less bleeding, whilst the incision lies on the surface of the exposed

portion of the stomach. Should a sharp foreign body be definitely impacted in some other part of the anterior wall, however, it may be advisable to make the incision directly over it. The opening should be free enough to allow the foreign body to be withdrawn without stretching or damaging the stomach walls, as an increase in the length of the incision is of no consequence in comparison with the risk of bruising the stomach. The serous and muscular coats are first divided with a knife, and then the cut edges are seized with forceps and raised by an assistant so that the escape of the stomach contents is prevented when the mucous membrane is incised. The mucous membrane is picked up with forceps, and a small hole made into it with a knife, the incision being completed with blunt-pointed scissors. The foreign body will now be exposed, or, if not, it is felt for and removed by suitable forceps, the incision in the stomach being enlarged if necessary in order to enable it to be extracted without force. There is no difficulty in removing it if the incision is of sufficient size, and the foreign body should be manœuvred so as to bring its shortest axis out through the wound. If, however, the body is actually perforating any of the gastric coats it must be disentangled with the greatest possible gentleness, and great care must be taken not to cause a perforation in so doing ; if necessary it may be broken up with cutting-pliers and removed piecemeal. The seat of impaction should be examined to see whether the stomach wall has been damaged and if so, this must be treated either by excision or by inversion and suture of the stomach walls. When the foreign body is impacted in the anterior wall, the incision should be made directly over it ; the surgeon can cut out the damaged portion of the wall and obtain a healthy surface for suture. After the foreign body has been removed, the incision in the stomach wall is held up by the assistant and is sutured as described on p. 243. The anterior surface of the stomach is then cleansed, the abdominal cloths are removed, the stomach is dropped back into place, the abdominal wound closed in the ordinary manner (see p. 215), and the usual dressings applied. There is no risk of fouling the abdominal cavity if the abdominal cloths are properly arranged, and no drainage is necessary. The after-treatment is identical with that for wounds of the stomach (see p. 248).

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CHAPTER XVII.

GASTRIC ULCER.

SIMPLE ulcer of the stomach occurs much more frequently in women than in men. The usual age of those suffering from it is between twenty and forty in women, while in men the average is ten years later; it may, however, occur up to an advanced period of life. The ulcer is most common upon the posterior wall and lesser curvature of the stomach near the pyloric end. It is said that in not more than 5 per cent. of all the cases is the ulcer situated upon the anterior wall, but on the other hand, something like 80 per cent. of all the fatal perforations following ulcer occur in that situation. As a rule the ulcer is single; it is rare for more than two to coexist, and sometimes an ulcer occurs in the duodenum as well as in the stomach. The ulcer itself is usually round or oval, but it may be irregular in outline, either from extension of the original ulcer or from the confluence of isolated ones. The edges are quite clean-cut, and the ulceration may only involve the superficial portion of the mucous membrane, or the submucous and muscular coats may be entirely destroyed. There is no constant relation between the depth of the ulcer and its size; a small ulcer may penetrate deeply, and *vice versâ*. When the ulcer is of recent development, the stomach walls in its immediate vicinity are not much altered; when, however, it has lasted for a long time, there may be extensive induration, giving rise to characters often mistaken for malignant growth—the so-called 'leather-bottle stomach' (see p. 253). The rest of the stomach is usually normal except that the pylorus is unduly contracted.

We may also refer to those cases in which hæmatemesis occurs, but in which the mucous membrane when examined during life, shows no definite ulcer; in these the blood appears to ooze continuously and in large quantities from minute erosions or abraded surfaces scattered over the mucous membrane of the stomach or gathered together into groups. In other cases very minute, almost pin-point ulcers are present extending deeply, and exposing the small submucous arteries; these two causes

of acute gastric hæmorrhage have been named by Dieulafoy 'simple erosions' and 'exulceratio simplex' respectively, and their treatment is sometimes a source of embarrassment to the surgeon.

RESULTS.—An ulcer which has existed for some time usually gives rise to various important sequelæ, and it is chiefly in connection with these that the surgeon is called in. The following are the principal complications :—

1. Hæmorrhage.—As the ulceration deepens, hæmorrhage—which may be capillary, venous, or arterial in nature — may result. As a rule hæmorrhage from a large artery is rare, but sometimes one may be opened into, especially in ulcers situated near the lesser curvature of the stomach or in the neighbourhood of the pancreas ; if this happens the bleeding may be so severe as to jeopardise the patient's life in a very short time. In the more frequent forms of hæmorrhage the bleeding is not so severe and generally ceases spontaneously after a time ; the risk under these circumstances is the production of profound anæmia as the result of the repeated bleedings. The blood so poured out may be vomited or may pass into the bowel ; if the latter is the case, it generally is an indication that the bleeding is severe, as in slight cases the blood becomes digested and can only be detected in the fæces as so-called 'occult blood' (see p. 235). As a rule the severe hæmorrhage that threatens life by its mere volume is associated with an acute gastric ulcer ; in the typical chronic ulcer the bleeding is less abundant, although it recurs frequently.

2. Interference with the gastric functions by the contraction accompanying healing.—When a gastric ulcer heals, or attempts to heal, the tissues around become indurated, as in ulcers elsewhere, and the scar contracts. The wall of the stomach consequently becomes thickened, and its cavity may be severely distorted by the subsequent contraction. This thickening—which passes off to some extent when the ulcer has actually healed, but which is very marked while the ulcer exists and has lasted for a long time—may be so great as to give rise to the suspicion of a tumour, and not uncommonly, even after the stomach has been exposed, it is difficult to decide whether the thickening is due to a simple ulcer or to a malignant tumour. In some cases the induration is diffused over nearly the whole of the stomach wall, so that when it is cut into, the viscus has rigid walls and does not collapse. This condition has been described as a clinical entity under the term '*fibromatosis of the stomach*' or the '*leather-bottle stomach.*' It is, as a rule, quite easy to trace the individual coats of the stomach throughout the affected area on section, and this distinguishes it at once from the infiltration of a carcinoma. The absence of hard enlarged glands is also against the diagnosis of carcinoma.

Apart from thickening of the stomach walls—which is by no means of constant occurrence—contraction always follows healing of the ulcer, and it depends upon the position and extent of the latter whether the functions

of the stomach are interfered with or not. When the ulcer is situated near the pyloric orifice and is of any considerable size, the contraction during healing narrows the pylorus and interferes with the passage of food through it; this stenosis may progress to such an extent as to obliterate the pylorus almost completely. The stomach in consequence becomes dilated, and the symptoms of a dilated stomach are present in addition to those of gastric ulcer.

Dilatation of the stomach is a frequent accompaniment of gastric ulcer at some period of its course. In the slight cases this dilatation may arise from the spasm of the pylorus, which commonly accompanies a gastric ulcer. It is usually due, however, to cicatricial narrowing following upon the contraction of an ulcer in the vicinity of the pylorus, or to perigastric adhesions. The dilatation of the stomach in such circumstances is a result of obstruction to the passage of food.

As the ulcer deepens, the peritoneal coat covering its base becomes inflamed, and adhesions may occur between the stomach and other parts, and interfere with the functions of the organ by their contraction. This perigastritis is frequent in ulcers that have extended deeply into the coats of the stomach, and is of great importance, partly because it interferes with the movements of the organ and partly because it may act beneficially in affording some protection against perforation.

The exact effects of perigastritis will depend upon the situation of the ulcer; thus, when the latter is situated in close proximity to some other organ adhesion will occur, whilst, if it be on the anterior surface, cicatricial bands are likely to form. Adhesions are most frequent when the ulcer is at the pylorus, which may then become attached to the under surface of the liver, the gall-bladder, or the bile duct, and may become so distorted that the passage of the gastric contents through it is greatly interfered with. Similarly, an ulcer on the posterior surface causes the stomach to become adherent to the pancreas. Adhesions may also occur with the omentum, the transverse colon, or the diaphragm; they are not so common when the ulcer is on the anterior surface, and this explains the fact that an ulcer in that situation is the most common cause of fatal perforation.

The perigastritis occurring in connection with extensive ulcers on the anterior surface of the stomach may cause much distortion as healing occurs from contraction of the inflammatory material upon the peritoneal surface. This may give rise to a constriction passing from the upper border of the stomach to the lower and producing the so-called '*hour-glass contraction*'; the stomach is divided into two cavities with a passage of varying calibre between them. As a result, the cardiac portion of the stomach may become dilated to such an extent that the condition may not be diagnosed, the case appearing to be one of contraction of the pylorus rather than an hour-glass contraction of the stomach. Some authors limit the term hour-glass contraction to its strict meaning—namely, a

constriction situated exactly in the centre of the stomach ; but it is more convenient from the point of view of treatment to enlarge the term so as to embrace all contractions of the stomach which produce a circular narrowing of the cavity and divide it into two sacs, even though these be of very unequal size.

3. Perforation.—This is not an uncommon complication of gastric ulcer and may give rise to various results. When the ulcer perforates the stomach wall and there are no adhesions, the gastric contents are extravasated freely into the general peritoneal cavity and a general septic peritonitis is set up. When on the other hand, perforation occurs in a situation in which adhesions have occurred, the extravasation may not take place into the general peritoneal cavity, and localised suppurative peritonitis followed by abscess may occur. Occasionally, when the perigastritis has produced firm adhesions between the stomach wall and the neighbouring tissues, the entire thickness of the stomach wall may be destroyed by the ulcer without the occurrence of either peritonitis or suppuration. This is most common in the neighbourhood of the pancreas. It happens occasionally that the orifice through which the extravasation takes place is so minute that only a very small quantity can escape at a time. As a result, intense local irritation is set up and the area of perforation is soon shut off from the general peritoneal cavity. These perforations are sometimes termed subacute perforations or '*leaking ulcers.*'

The *pathology* of gastric ulcer is by no means clear. It is probable that the ulceration is preceded by thrombosis of the smaller vessels and that the ulcer is a necrotic process following the action of the gastric juice upon this area. It is very common in anæmic girls and it is probable that the anæmia may have something to do with the production of the ulcer. Hyperacidity of the gastric contents has also been assigned as a cause, but this explanation is not satisfactory, as hyperacidity is frequently met with unaccompanied by ulcer, and, conversely, hyperacidity is not invariably present in all cases of gastric ulcer.

SYMPTOMS.—The subjects of gastric ulcer are usually anæmic, thin, have a poor appetite, and complain of three principal symptoms : namely—pain, vomiting, and hæmatemesis.

Pain in well-marked cases is constant and of varying intensity. The exact period at which it supervenes after a meal varies to some extent with the position of the ulcer ; when this is situated near the cardiac end of the stomach, pain usually occurs immediately after taking food ; when at or near the pylorus, it may not come on for as long as an hour or two after a meal. An important diagnostic point is that the pain is increased by pressure. It is not uncommon for very neurotic subjects who are not suffering from ulcer to complain of pain after food, but this pain is usually relieved by pressure. The pain due to gastric ulcer is generally relieved by lying down, and some slight help in diagnosing the situation

of the ulcer may be obtained by noticing the position of greatest ease ; for example, if the dorsal position is the most comfortable, the probability is that the ulcer is situated on the anterior wall of the stomach ; if lying on the right side gives most ease, it is probable that the ulcer is near the cardiac end and *vice versâ*. The pain is in the middle line, and when the ulcer is near the cardiac end of the stomach it is generally complained of in the upper part of the epigastrium ; when it is at the centre of the viscus, it is near the middle, and when at the pyloric end, at the lower part of the same region. When the ulcer is on the anterior wall, there is marked tenderness in the epigastrium ; when on the posterior surface, the tender spot is to the left of the last dorsal spine.

Vomiting commonly occurs at some period in the course of a gastric ulcer, but its diagnostic importance is comparatively slight as it occurs so frequently in many other affections. If present it generally sets in some considerable time after food. It is invariably present when an ulcer in the region of the pylorus has cicatrised and the stomach has undergone dilatation, and then large quantities of food in a state of decomposition and undergoing yeasty fermentation are vomited at irregular and infrequent intervals.

Bleeding is the most certain sign of ulcer of the stomach, but it may be entirely absent, and even its presence is not certain evidence of the presence of a visible ulcer (see p. 252). When it is slight it is dangerous, more from the anæmia produced by the constant recurrence of the bleeding than from the actual loss of blood at any given time. In other cases the hæmorrhage is very grave and the patient may actually die from loss of blood, although this is very rare. Hæmorrhage from the stomach may occur in malignant disease and in other conditions such as cirrhosis of the liver, but the occurrence of occasional attacks of hæmorrhage from the stomach accompanied by pain and vomiting in a young chlorotic woman is almost pathognomonic of a gastric ulcer.

Hyper-acidity of the gastric contents due to an excess of free hydrochloric acid, is an almost constant feature in the acute stages of the affection, but is not diagnostic in itself and is not invariably present.

TREATMENT.—In the early stages, the treatment is essentially a matter for the physician, but when the disease is established surgical measures are being adopted in an increasing number of cases and often with the greatest benefit. We may summarise the chief circumstances under which the surgeon may be called in :—

1. When the symptoms are long-continued and do not yield to medical treatment, and particularly when profound anæmia is resulting from the repeated hæmorrhages.
2. To arrest hæmorrhage that threatens life.
3. When perforation has occurred.
4. To treat a sub-phrenic abscess.
5. To relieve constriction of the pylorus or an hour-glass contraction.

6. To relieve various indefinite symptoms, not necessarily due to the existence of the ulcer, but following the healing of one. These symptoms are generally due to adhesions which either alter the direction of the pylorus, constrict the stomach, or tether down the organ to adjacent structures.

TREATMENT OF CASES ACCOMPANIED BY PROFOUND AND INCREASING ANÆMIA.

MEDICAL TREATMENT.—The medical treatment has two primary objects—namely, to give physiological rest to the stomach, and to administer remedies calculated to promote healing of the ulcer. In the acute stage the patient should be strictly confined to bed and all nourishment should be given *per rectum* in the form of nutrient enemata; in addition, a large injection of normal saline solution should be given once or twice daily. If the latter does not check the thirst, the patient may be allowed to suck a little ice. As the symptoms improve, a milk diet may be cautiously given. Confinement to bed should be insisted on for six weeks. The pain is best relieved by large hot *fomentations* over the epigastrium and left side of the abdomen, but it may be so severe that hypodermic injections of morphine may be necessary; this drug is also sometimes useful in checking the vomiting.

Various sedative *drugs* may be administered by the mouth, of which bismuth, hydrocyanic acid, and morphine are the best. The following prescriptions may be used with advantage :—

℞ Liq. morph. hydrochlor. ℥x.
Bismuth. carb. . . gr. xv.
Sodii bicarb. . } āā gr. x.
Pulv. tragacanth co. }
Spirit. chlorof. . . ℥x.
Aq. menth. pip. ad ℥j.
Quartis horis.

or

℞ Bismuth. carb. . gr. xv.
Sodii bicarb. . gr. xx.
Acid. hydrocyanic. dil. ℥iij.
Æther. chlor. . ℥xv.
Aquam . . ad ℥j.
T. d. s.

It is advisable also to administer a saline aperient, such as Carlsbad or other waters, occasionally. Normal horse serum given by the mouth is strongly advocated by some, both in ulcer of the stomach and of the duodenum, and it seems to be especially of value when hæmorrhage is present. It should be given in doses of 10 to 20 c.c. twice a day until the hæmorrhage has stopped, and then once a day for a week.

Dr. Otto Grünbaum, Assistant Physician to the London Hospital, has been kind enough to furnish us with the following points relative to this important question of rectal feeding :—

Since the rectal injections often replace not only the solid but also the liquid part of the diet, they should consist of water, proteids, carbohydrates, and fats. If sufficient water cannot be absorbed by the large intestine and none may be given by the mouth, subcutaneous injections of sterile normal salt solution must be resorted to.

Before beginning rectal feeding the lower bowel should be emptied and cleansed by the administration of a copious warm-water injection; at least an hour must then elapse before the nutrient enema is introduced.

The best position for the patient is lying on the left side with the pelvis slightly raised on a pillow placed under the hips. A long soft rubber œsophageal tube is greased (glycerine must not be used) and carefully passed from six to twelve inches into the bowel; to the end of the tube a glass funnel is attached, and into it the enema (warmed to 99° F.) is poured. For the first ten minutes after the introduction of the enema the nates should be pressed together with a towel, and the patient ought to remain undisturbed for an hour.

The pressure under which the fluid is introduced should not exceed that due to a column of water two feet high; the fluid, flowing in slowly, finds its way into the sigmoid flexure and the descending colon, and therefore does not excite the desire to evacuate. This avoidable complication is often due to a sudden distension of the rectum which usually occurs if the injection be shot into the bowel with a syringe.

The volume and exact composition of the enema must depend upon the state of the mucous membrane of the large intestine. It is generally desirable to introduce at least two and a half ounces (80 grms.) of proteid, three and a half ounces (100 grms.) of carbohydrate, and five drams (20 grms.) of fat per diem. This, if 50 per cent. were absorbed, would represent a quarter of the energy required by a patient lying in bed in a room at 62° F.

The constituents of the enema must be unirritating and easily absorbed; the following have been used with success and are usually retained without trouble :—

Glucose . . ℥vj.	Albumose[1] . ℥ij.	Ox serum . . ℥v.
Milk . . ℥iv.	Milk . . ℥vij.	Milk . . . ℥ij.
Starch (raw) . ℥j.		Glucose or Starch ℥vj.
Salt . . . ℥ss.		
Sextis horis.	Sextis horis.	Sextis horis.

Occasionally it is found that the addition of a few minims of liquor pancreaticus improves absorption, but this preparation must not be added to an enema containing more than 10 per cent. of starch, lest the mucous membrane be irritated by the strong solution of sugar which would be rapidly formed. The proteids in eggs and milk are not so readily absorbed as those in serum, but the latter has been known on rare occasions to give rise to slight urticaria. The prolonged administration of albumose may lead to colitis.

Nutrient enemata must not be stopped if the first few be returned; a tolerance is often established after two or three have been given. If, however, tolerance be not established, an ounce of red wine added to the enema has frequently been found to produce the desired result.

If no formula proves satisfactory, even when only three ounces are introduced at a time, recourse must be had to a small boiled starch enema (1 oz.) containing ten to twenty minims of tincture of opium followed an hour later by a nutrient injection.

The rectum must be washed out daily with an enema of warm normal saline. Nutrient suppositories cannot be recommended, for, even if they were absorbed, more than sixty would be required daily to supply the necessary energy.

The absorption of fat is found to be so variable a factor in different individuals that it is often wise to adopt a supplementary method of administering it when prolonged abstinence from oral feeding is indicated. An ounce or two of sterile olive oil may be injected into the subcutaneous tissue of the groin every second day. No untoward effects follow this procedure, whilst the fat thus introduced is slowly utilised and may materially diminish the fall in the weight of the patient.

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[1] Witte's peptone.

SURGICAL TREATMENT.—The indications for surgical interference have been given on p. 256. The measures employed aim at removing the ulcer, or at placing the stomach under conditions favourable to the healing of the ulcer or at both combined. The second aim may be carried out surgically either by enlarging the pyloric opening, or by forming a new communication between the stomach and the intestine.

Of these methods the second is more often applicable. Excision of the ulcer, although theoretically the better procedure, is often not advisable, and its results may be disappointing. A large proportion of the ulcers are so situated that excision is out of the question ; even when it is feasible, the procedure may involve an extensive operation in a subject unable to undergo it. Finally the wound made by excision of the ulcer may fail to heal or a fresh ulcer may develop independently elsewhere ; the hyperacidity of the stomach contents and the spasm of the pylorus are not affected by excision of the ulcer and the original cause of the ulceration may still remain active. When the ulcer is easily reached and is small, however, it is good treatment to excise it, but in most cases this should be supplemented by pyloroplasty or gastro-jejunostomy, so as to provide for the free escape of the stomach contents and enable the organ to get rest. The ulcers best suited for this method of treatment are those situated on the anterior wall of the stomach.

Gastro-jejunostomy.—The operation that we advocate for chronic ulcer of the stomach in suitable cases is gastro-jejunostomy, or the formation of a permanent artificial opening between the stomach and the small intestine. This operation is, however, only satisfactory when the pylorus is narrowed as the result of the disease or is artificially narrowed by the surgeon. Some surgeons however—notably Kocher—prefer gastro-duodenostomy when it is feasible.

There are two methods of performing gastro-jejunostomy, according to the surface of the stomach to which the bowel is attached: namely, anterior and posterior gastro-jejunostomy. The anterior form is subdivided into the pre- and post-colic forms, in the former of which the loop of jejunum is brought up around the lower edge of the omentum in front of the transverse colon and attached to the anterior surface of the stomach, while in the latter the transverse meso-colon and the gastro-colic omentum are perforated and the loop of the jejunum is drawn through the slit thus made and attached to the anterior wall of the stomach. Fig. 92 indicates diagrammatically the principle of these operations ; the pre-colic form is the one in common use. There are also two methods of performing the posterior operation: namely, the ' loop ' and ' no-loop ' methods ; in the former some distance intervenes between the duodeno-jejunal junction and the anastomosis, while in the latter the anastomosis is made as near the junction as possible. The latter method would appear to be safer, since there is no long loop that may become distended with bile and intestinal contents.

Advantages of the different methods.—Both the anterior and posterior operations are suitable in certain cases. The *anterior operation* is the easier and involves less disturbance of the parts than the posterior. It is especially suitable for cases in which the ulcer is extensive and situated on the posterior wall and the stomach is bound down to the pancreas or other surrounding structures. It may also be employed when the patient is very ill and it is of importance to disturb the parts as little as possible. Further, when an ulcer has been excised from the anterior surface of the stomach, it may be advisable in some cases to utilise the opening so formed for the purpose of a gastro-jejunostomy, and in that case the anterior operation is performed. The chief objections urged against the anterior operation are that kinking is apt to occur at the junction with the stomach, that if the colon becomes distended or if much fat is deposited in the omentum, the limbs of the small intestine may be unduly compressed or *vice versa* that the small intestine may compress the colon, that hernia may occur under the loop of small intestine, and that 'peptic ulcer' of the jejunum is more apt to occur after it than after the posterior form. The first two conditions may give rise to regurgitant vomiting or the formation of the 'vicious circle'; and with the view of avoiding that occurrence, the general rule is not only to connect the small intestine to the stomach but also to connect the two limbs before they turn up over the colon, or else to perform Roux's Y-operation, which is described on p. 271. It was with the view of avoiding these troubles and also those incident to the posterior operation that gastro-duodenostomy was introduced by Kocher. This operation is described on p. 278, but we may say here that it has not been taken up very much, chiefly no doubt because many ulcers are situated at or near the pyloric orifice.

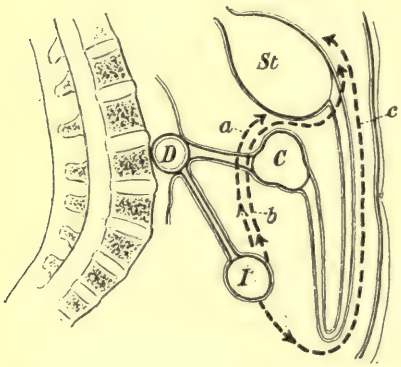

FIG. 92.—DIAGRAM ILLUSTRATING THE VARIOUS METHODS OF PERFORMING GASTRO-JEJUNOSTOMY. The dotted lines indicate the direction in which the small intestine (I) is carried. Thus *a* is the posterior gastro-jejunostomy, *b* is the retro-colic, and *c* the ordinary or pre-colic form of anterior gastro-jejunostomy. *St* = stomach. *D* = duodenum.

In spite, however, of the objections mentioned above, the anterior operation still has its place under certain circumstances and must not be altogether cast aside. In our opinion, however, the retro-colic variety is unreliable and not to be recommended, as strangulation of the jejunum is very apt to occur at the aperture through which the loop has to pass in order to reach the anterior surface of the stomach; if this aperture be made sufficiently large to avoid all possible danger

of strangulation, there is a risk of interfering with the vascular supply in the meso-colon.

The *posterior operation*, especially by the 'no-loop' method, has the advantage that the communication is more direct and kinking is less likely to occur than in the anterior, that the junction takes place at the commencement of the jejunum, and that there is no interference with the colon or risk of internal hernia. The objections are that there is more disturbance of the parts than in the anterior, that great care must be exercised as regards the direction of the loop, and should regurgitant vomiting occur in the case of the 'no-loop' method, an anastomosis between the limbs is very difficult, and the union between the stomach and bowel may have to be undone.

On the whole we advise the posterior operation whenever it can be done, as it can be in the great majority of cases. The best results, by either method, are obtained when there is some stricture of the pylorus; when this is not present, the results are unsatisfactory, as the food still goes on by the pyloric route and a certain amount of regurgitant vomiting is not uncommon. Hence if no narrowing of the pylorus is present, either the operation should not be done, or if it is considered necessary, sero-muscular stitches must be applied around the pylorus so as to narrow its lumen.

The chief points to avoid in performing the operation of gastro-jejunostomy are the occurrence of sepsis, the development of regurgitant vomiting ('vicious circle'), and the subsequent contraction of the anastomotic opening.

Great care must be taken to pack off the field of operation from the general peritoneal cavity and to prevent the escape of the contents of the stomach or intestine and soiling of the peritoneum; at one time a considerable part of the mortality after this operation was due to sepsis.

The chief trouble after the operation and the ordinary cause of a fatal result is regurgitant vomiting or the occurrence of a 'vicious circle.' In bad cases the patient may die within a fortnight, but sometimes the obstruction is only partial and the patient lives, but frequent vomiting occurs along with dyspeptic symptoms and his health suffers greatly. The occurrence of a 'vicious circle' may be suspected if the patient begins to vomit persistently on the third or fourth day after the operation; vomiting occurring earlier may be due to the anæsthetic. In this condition the contents of the stomach, instead of passing directly down the efferent limb of the intestine, as is intended, pass in whole or in part into the upper or afferent limb which becomes greatly distended, and discharges its contents (stomach contents, bile, and pancreatic juice) back into the stomach either through the pylorus or through the anastomotic opening.

Causes of 'vicious circle.'—This condition is due to various causes. It is not infrequently met with when the operation has been performed in cases in which there is *no contraction of the pyloric orifice of the stomach*,

and the operation has proved so very unsatisfactory under such circumstances that it is becoming the rule not to perform it when the pylorus is quite patent, or, if it is done, to take steps to constrict the pylorus. It has been found in experiments on animals, that when the pyloric orifice is patent, it is only in a small proportion of cases that the stomach contents pass directly down the efferent limb of the intestine; in some they still pass through the pylorus and re-enter the stomach through the anastomotic opening, in others exactly the opposite occurs, and in others again they pass into the afferent limb through the anastomotic opening and then regurgitate into the stomach through the same opening. The conclusion seems to be that when gastro-jejunostomy is performed and the pylorus is patent, either that orifice must be constricted by stitches applied outside it or Roux's Y-shaped anastomosis or a lateral anastomosis between the limbs of the intestine should be employed.

Other causes of a 'vicious circle' are connected with some *error in the technique of the anastomosis, e.g.* the formation of a spur at the point where the efferent limb leaves the opening, the occurrence of a kink in the intestine beyond, the presence of a long loop before the anastomotic opening which may become twisted on itself, or a twist in the efferent loop; lastly the opening made in the meso-colon in order to permit of the application of the jejunum to the posterior wall of the stomach may be too small or may not be properly fixed, and may constrict the intestine. The introduction of the 'no-loop' method has obviated some of these difficulties to a considerable extent; twisting of the intestine on the proximal side of the anastomotic opening is no longer possible and kinks at or beyond the opening should not occur.

Perhaps the most common cause of the condition is the *formation of a spur* in the intestine at the site of anastomosis, which guides the contents of the afferent loop into the stomach and prevents them from passing along the intestinal tract. This spur also makes it easier for the stomach to expel its contents into the duodenum than along the ileum. The dilatation of the duodenal loop that follows this backward propulsion of the stomach contents still further displaces the spur, so that it may ultimately act as a valve and completely occlude the efferent loop. Another cause of the affection is an *unduly long loop between the pylorus and the anastomotic opening.* When there is any considerable interval between the end of the duodenum and the anastomotic opening, the weight of the loop when filled with bile and pancreatic secretion tends to cause such an acute kinking at the stomach orifice that the bile cannot find its way into the ileum. A third, and most important, cause met with in the posterior form of the operation, is an *insufficient opening in the transverse meso-colon,* or imperfect attachment of the edges of this opening to the stomach. If the edges are imperfectly attached to the stomach, the meso-colon may slip downwards when the operation has been completed, and the narrow opening in it constricts both the afferent and efferent loops, squeezing them together

and forming an acute kink at the site of anastomosis. Occasionally, though very rarely, there may be a *volvulus* at the anastomosis, the efferent loop being twisted on itself over to the left side of the spine.

An insufficient anastomotic opening.—Although the question of the 'vicious circle' is all-important as regards the patient's recovery from the operation, another point of the greatest practical importance is that the anastomotic opening should be sufficiently free to answer the purposes for which it is required. The anastomotic opening, being composed of cicatricial tissue, is rigid and has a constant tendency to contraction, and as the opening becomes smaller, recurrence of the symptoms is apt to take place and food may indeed cease to pass through it. In addition to the narrowing due to contraction it must be borne in mind when the anastomosis is performed for dilatation of the stomach, that the organ will contract after the obstruction has been relieved until it has resumed its normal size, and with this contraction there must be *pari passu* some diminution in the size of the anastomotic opening; thus an opening which was satisfactory at first may become so small that the symptoms recur.

The only remedy against this danger is to make a large anastomotic opening in the first instance, and the only way in which the surgeon can be certain of doing this is to make the junction by simple suture. If mechanical aids (such as Robson's bobbin or Murphy's button) are employed, the size of the opening is determined by the size of the button employed, and in a gastro-jejunostomy, the maximum size of the opening will be the size of the largest bobbin or button that can be inserted into the small intestine without unduly pressing on its walls. In most cases this is much too small, as only a small bobbin can be inserted into the jejunum. By simple suture, on the other hand, the surgeon can make an opening of considerable length in both viscera. When the operation is done in the case of a greatly dilated stomach, the opening should be made especially large in order to allow for the shrinkage of the stomach which must occur subsequently.

The operation.—Whichever operation be chosen, the *preliminary steps* are identical. The stomach should be washed out before the operation so as to lessen the risk of vomiting under the anæsthetic and to obviate the escape of gastric contents into the abdominal cavity during the operation if the surgeon does not apply a clamp to the stomach. The preliminary washing out of the stomach also diminishes the post-operation vomiting; it is described on p. 235.

The most suitable *anæsthetic* is chloroform; in feeble and aged persons the A.C.E. mixture may be employed; but ether should be avoided, as it causes congestion of the intestines, promotes peristaltic action, and does not insure such complete relaxation of the abdominal walls as does chloroform. This objection does not apply, however, to the intravenous administration of the drug (see p. 32) which may be very valuable in

feeble subjects. Spinal analgesia may also be used, but there is often some difficulty in regulating the administration so as to get a sufficiently high limit of analgesia; besides this, the patient, though quite unconscious of pain, may suffer a good deal of shock from the disturbance of the large sympathetic plexuses. Spinal analgesia is especially valuable when the operation is done for a perforated gastric or duodenal ulcer.

The *incision* should be vertical, commencing above, about an inch to the right of the middle line and carried downwards to the level of the umbilicus. The abdominal cavity having been opened in the manner

FIG. 93.—POSTERIOR GASTRO-JEJUNOSTOMY. *Identification of the Jejunum.* The stomach and great omentum have been turned up on to the chest and covered with an abdominal cloth. The under surface of the transverse meso-colon covering the posterior surface of the stomach is fully displayed, and the fossa duodeno-jejunalis is well seen. The coil of small intestine grasped by the hand is the commencement of the jejunum.

already described (see p. 215), the anterior surface of the stomach, which either presents spontaneously or is readily exposed by pushing down the colon, is explored for the presence of an ulcer, and if one is found, it should be carefully examined to see if it can be excised (see p. 279). If so, this may be done, and the wound in the stomach either closed by sutures, or, if in a suitable position and of convenient size, subsequently utilised as part of an anterior gastro-jejunostomy.

Whether the ulcer be excised or not, the next step is the *identification of the jejunum* (see Fig. 93). The omentum and the transverse colon are raised and pulled well up out of the abdominal wound, when it is usually easy to identify the first few inches of the jejunum just after its junction

with the duodenum. The upper part of the jejunum may be attached to the meso-colon by adhesions; if these are present they should be detached and the jejunum freed up to its origin. If the jejunum is not obvious at once, the hand is passed along the under surface of the transverse meso-colon to the left side of the spinal column. The portion of small intestine found in this situation is seized and pulled up. If it is the jejunum—as will probably be the case—it is fixed to the side of the spine, and is thus easily identified. The further steps will depend upon whether the anterior or the posterior variety of the operation is to be performed.

Posterior gastro-jejunostomy.—After the jejunum has been identified, the stomach, with the great omentum and the transverse colon, are pulled as far out of the abdomen as they will come and turned up upon the costal margin and covered with abdominal cloths. This exposes the transverse meso-colon covering the posterior wall of the stomach. An opening at least three inches long is made in the former structure over the spot at which it is proposed to make the anastomosis (*i.e.* close to the greater curvature and rather towards the cardiac end) by tearing it parallel to the direction of the vessels and pulling the edges of the rent asunder so as to expose the stomach freely ; this should be done through an avascular area if possible, but any vessel in the way must be divided between clamps and ligatured. It is not, however, permissible to ligature any of the main colic vessels. In order to prevent the edges of the opening in the meso-colon from coming together again, they are attached by a few catgut stitches to the posterior wall of the stomach, thus exposing the whole area of the latter that is required for the anastomosis (see Fig. 94). If this precaution is neglected, the opening in the meso-colon may constrict the intestine, and, moreover, the patient may subsequently become the subject of a retro-colic hernia. This union of the meso-colon may be done when the anastomosis has been completed, if preferred. The jejunum, which has been given to an assistant to hold, is now taken, and the site for anastomosis selected.

At one time great stress was laid on applying the jejunum to the stomach in such a way that the peristaltic wave should follow the same direction in both. This was done by turning round the coil of the jejunum and applying it to the stomach in a direction from left to right. In these cases a loop was formed and one of the conditions for the development of the ' vicious circle ' was provided. Of late years this plan has been given up in favour of the ' no-loop ' method in which the jejunum, as close to its commencement as possible, is applied directly to the stomach without regard to the peristaltic wave. The line of union in the stomach when completed runs either more or less directly downwards from nearly the middle of its posterior surface towards the lower border or with a slight obliquity to the left. The opening in the stomach should be rather nearer the cardiac than the pyloric end of the great curvature ;

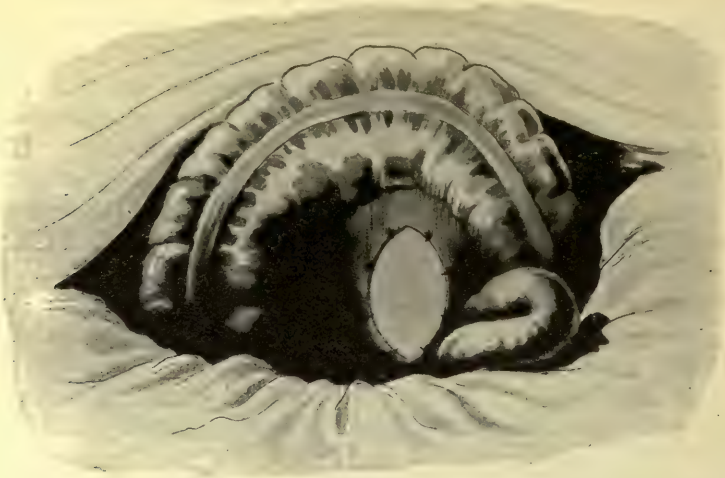

FIG. 94.—POSTERIOR GASTRO-JEJUNOSTOMY. *Exposure of the posterior wall of the stomach.* The slit in the transverse meso-colon has been converted into an ellipse and its edges fastened to the posterior gastric wall by sutures. This is the spot chosen for the anastomosis. The exposed stomach wall has been drawn light in colour for the sake of contrast.

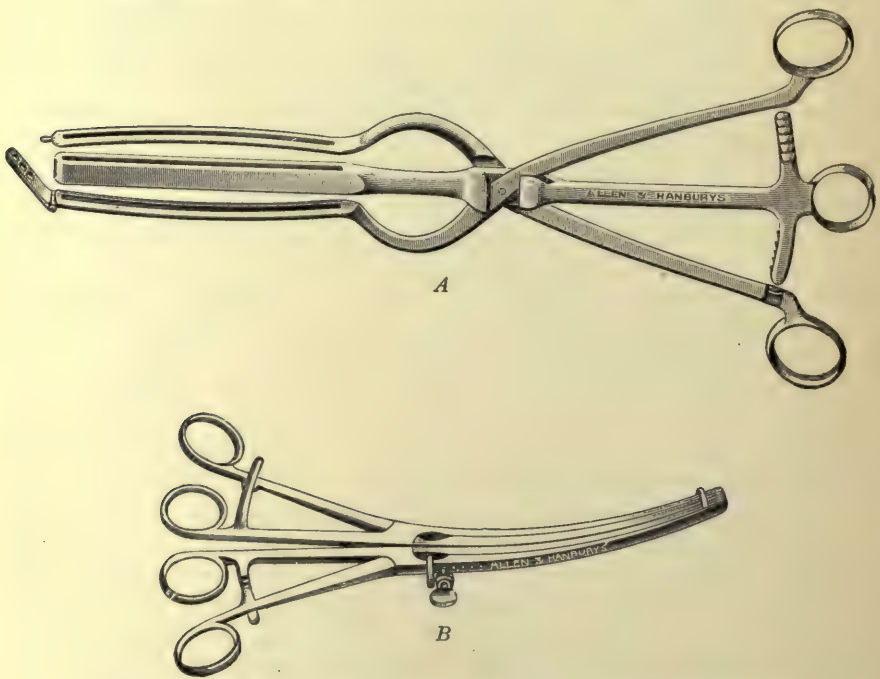

FIG. 95.—CLAMPS FOR GASTRO-JEJUNOSTOMY. *A* is the clamp originally introduced by Roosevelt. It is very efficient, but rather more clumsy than *B* which is the form introduced by Lane. These are lighter and more handy to apply. They can also be used for enterectomy, as shown in Fig. 116.

if it is too near the pyloric end, the bowel is apt to be kinked at the point where it leaves the pancreas, when the stomach resumes its normal position.

The stomach is now lifted up and the portion selected for the anastomosis is pushed through the opening in the meso-colon from the front by the left hand, so that the posterior wall can be grasped by the right hand and pulled through the opening in the form of a vertical fold or ridge with its long axis running from the lesser to the greater curvature. This portion of the posterior wall, three to four inches in length, is now included in one blade of a clamp, shown in Fig. 95. The clamp should be applied parallel to the long axis of the patient's body, the handles pointing towards the feet, the points towards his head. The loop of jejunum, also three to four inches in length, is next taken, pulled taut at the duodeno-jejunal junction, emptied of its contents by gently passing it between the fingers and then secured in the other blade of the clamp. Before closing the clamp, a long narrow strip of gauze is placed beneath its centre, opposite to the point where the posterior line of sutures will be inserted. The object of this is to catch any of the intestinal contents that may escape when the viscera are opened, and it must be thick enough for this purpose and long enough for its ends to escape from the wound, so that there shall be no danger of its being left behind. As the jejunum is being clamped, the forceps are rotated so that they now lie horizontally, the handles facing the assistant and the points facing the surgeon. When the clamp is in place, the stomach, omentum, and transverse colon are pushed back into the abdomen and kept in place within it by a large abdominal pad. Large hot abdominal cloths are then laid over the abdominal wall and their edges drawn up underneath each end of the clamp until they surround this portion of stomach and jejunum and the edges of the abdominal incision in every direction. The entire suture can thus be carried out outside the abdomen which is protected from infection by the gastric or intestinal contents. This packing may be reinforced by thick gauze swabs, which receive any fluids that escape when the incisions are made into the stomach and the jejunum, and can be changed at once.

The first suture to be applied is a continuous stitch of fine catgut threaded on a large fully-curved round intestinal needle and introduced through the serous and muscular coats of the jejunum and the stomach, beginning about half an inch beyond one end of the proposed incision. This end is left long and caught in Spencer Wells's forceps, whilst the surgeon proceeds to connect the opposed surfaces of the jejunum and the stomach about a quarter of an inch below the proposed line of incision (see Fig. 96). This suture extends about half an inch beyond the other end of the proposed incision, when it is knotted and the end left long. This secures the serous surfaces together throughout the whole of the posterior portion of the anastomosis. The surgeon then makes the incisions in the stomach and jejunum about two inches in length through

the sero-muscular coats only in the first instance. It is well then to separate them from the mucous membrane for a short distance on either side, leaving an elliptical portion of the latter exposed. This elliptical area is then snipped away with scissors, thus removing redundant mucous membrane and facilitating the subsequent suture. Both stomach and jejunum are treated in a similar manner. Anything that escapes from the opening is carefully wiped up on mops that are not used again during the operation. A suture of stout catgut is now taken and the adjacent lips of the openings in the stomach and the jejunum are united, the edges being approximated by catch forceps. This suture should commence at one end of the incision, and, going through all the

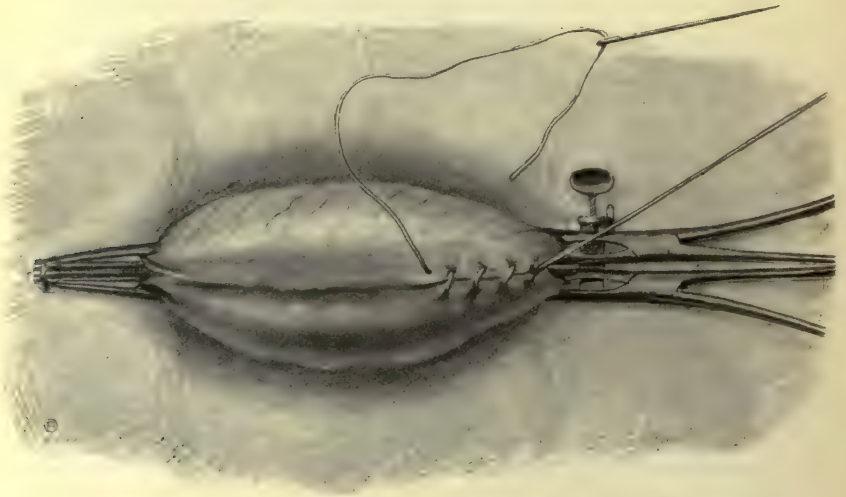

Fig. 96.—Posterior Gastro-jejunostomy. *Attaching the Jejunum to the Stomach.* The continuous sero-muscular suture to form the posterior half of the outer ring of suture is being inserted. The right-hand end is left long for subsequent use.

coats on both sides, firmly unites them and by its pressure stops any bleeding (see Fig. 97). As this suture, if carried round the entire circumference of the anastomosis, would leave portions of the mucous membrane projecting on the anterior aspect of the union, it becomes necessary to make some little alteration in the method of its insertion in the anterior half. The posterior half of the stitch is generally begun at the extreme left end of the posterior aspect of the anastomosis, and is carried, as a simple running suture, as far as the right end of the posterior aspect ; then, in order to turn the corner, the stitch is changed to the pillow-maker's stitch, the details of which are shown in Fig. 98 and which has the effect of invaginating the mucous surfaces as it is pulled tight. This is an excellent stitch and very simple, and should be practised by, and be quite familiar to, all who have to perform intestinal suture. When the stitch

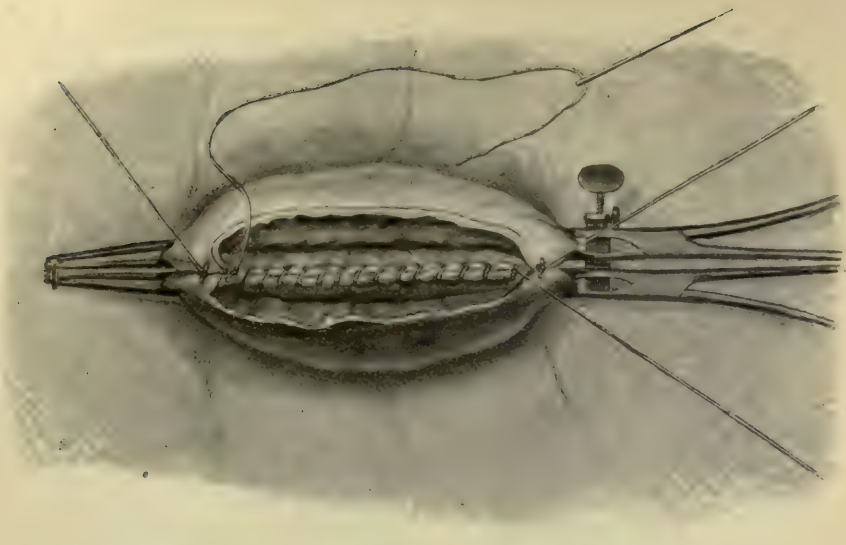

FIG. 97.—POSTERIOR GASTRO-JEJUNOSTOMY. *Insertion of the posterior half of the 'through-and-through' suture.* The suture at its commencement is left with one end long for future use. It is pulled quite tight each time the needle is passed, as there is no fear of puckering up the opening owing to the fixation of the edges by means of the clamp, which also acts as a temporary hæmostat, the through-and-through suture eventually taking its place.

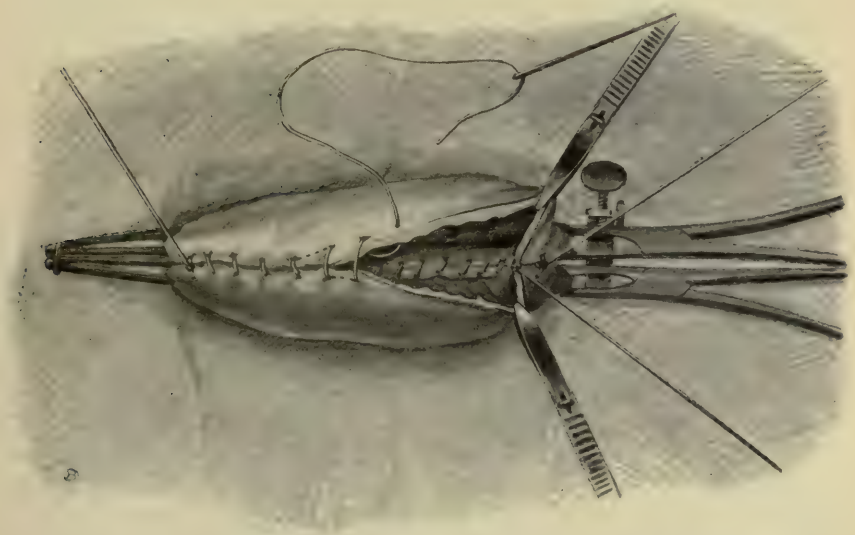

FIG. 98.—POSTERIOR GASTRO-JEJUNOSTOMY. *Completing the 'through-and-through' suture.* The illustration shows how the 'pillow-maker's' stitch is inserted. It is substituted for the running suture at the left-hand end of the anastomosis. The dotted line shows the course of the suture inside the lumen of the gut.

reaches the extreme left-hand end of the anastomosis, the two ends of the suture are tied together and the union should be water-tight. As this deeper suture is introduced, each loop of it is pulled fairly tight so that it shall be effectually hæmostatic. There are, however, often three or four small bleeding points that it is well to ligature, especially in the jejunum, and we have always found it an excellent precaution against serious post-operative bleeding to relax each limb of the clamp separately before the anterior part of this deep hæmostatic suture is inserted and again before it is completed, as this enables an uncontrolled vessel to be recognised and ligatured.

As soon as the deep suture has been inserted and tied, the joint is

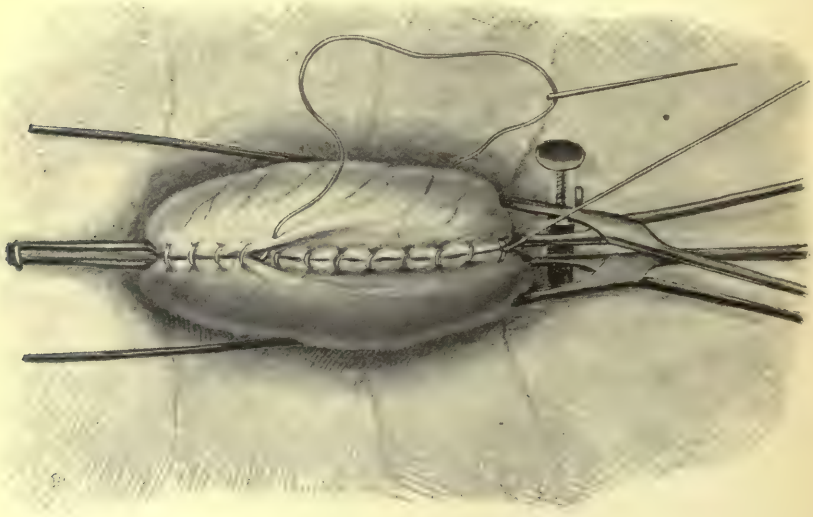

FIG. 99.—POSTERIOR GASTRO-JEJUNOSTOMY. *Completing the outer layer of suture.* When the suture is brought to the right-hand end of the anastomosis the two ends are tied together. The clamp is relaxed to facilitate the drawing together of the serous surfaces.

water-tight and the clamps and the posterior packing are removed. This greatly facilitates the next step—namely, the completion of the external suture, the ends of which have been left long and caught in forceps. This takes up the adjacent sero-muscular surfaces about a quarter of an inch external to the deep suture just inserted (see Fig. 99). When this suture has reached the left side, the two ends are tied together and cut short. The continuous suture uniting all the coats is thus completely buried. If the sides of the opening in the gastro-colic omentum have not been already fixed, this should now be done. Lastly the packing is removed and the abdominal wall is closed in the usual way by suturing it in layers (see p. 216); and if the patient is collapsed, it is well to fill up the abdominal cavity with as much hot normal saline solution (105° F.) as it will hold

before it is completely closed; if necessary, subcutaneous infusion of saline solution may also be resorted to.

Anterior gastro-jejunostomy.—For reasons already given (see p. 260) we shall only describe the pre-colic form of this operation.

After the jejunum has been identified and its direction made out (see p. 264), the stomach with the transverse colon and the omentum are replaced in position in the abdomen and a portion of the jejunum is selected that will easily rest on the anterior surface of the stomach without any tension and without constricting the transverse colon, across which it must of course pass. It is essential for the success of the operation that the intestine should not cramp the movements of the transverse colon or *vice versa*. The anastomosis is usually satisfactory if a point about twelve to eighteen inches from the commencement of the jejunum is selected. If the distance be much greater than this, a heavy intestinal loop will be formed between the duodenum and the anastomotic opening and this, when filled with bile and pancreatic secretion, might pull unduly and cause a 'vicious circle.' When choosing the loop, care must also be taken to see that the peristaltic current is in the proper direction—namely, from left to right. One limb of the clamp is then applied obliquely across the stomach from above downwards and to the right, and the portion taken up in it should be close to the greater curvature, and nearer the pyloric than the cardiac end (unless the operation follows excision of an ulcer, when the anastomosis will be made at that spot). The jejunal loop is then fixed in the other limb of the clamp and the subsequent steps are identical with those of the posterior operation. At the conclusion of the suturing it is a good plan to insert two or three sero-muscular sutures on each side, so as to prolong the outer sero-muscular suture along the upper limit of the anastomosis (see Fig. 100) and thus ensure that neither the afferent nor the efferent loop can become kinked at the anastomotic opening. This is a point of the very highest practical importance. Should the surgeon find that kinking does occur and that it is impossible to rectify it by suturing in this manner, he must either divide the small intestine on the proximal side of the anastomosis, invaginate and close the end next the opening in the stomach, and implant the other end laterally into the intestine below the anastomosis—*i.e.* the Y-method of gastro-jejunostomy (*vide infra*)—or he must make a lateral anastomosis between the afferent and the efferent loops of the jejunum well below the opening into the stomach (see Fig. 101). The latter can be done very quickly, and absolutely prevents the development of a 'vicious circle.'

The Y-operation.—This method is especially applicable when it is impossible to fix the intestine to the stomach without kinking—as may be the case when only a small portion of healthy stomach wall is available for anastomosis. In it the jejunum is divided about ten inches from its junction with the duodenum, and the distal end is implanted into the stomach, while the proximal end is implanted into the jejunum below the

point where the small intestine passes over the colon (*vide infra*). In this operation the contents (bile and pancreatic secretion) of the proximal or duodenal loop enter the jejunum well below the orifice in the stomach, whilst the gastric contents have no option but to travel in the right direction along the distal loop. Theoretically, this is a most satisfactory operation; practically, it is somewhat complicated and is apt to take a good deal of time and thus to be too severe unless the patient's condition is good.

The simplest way to perform the operation is to proceed as for gastro-

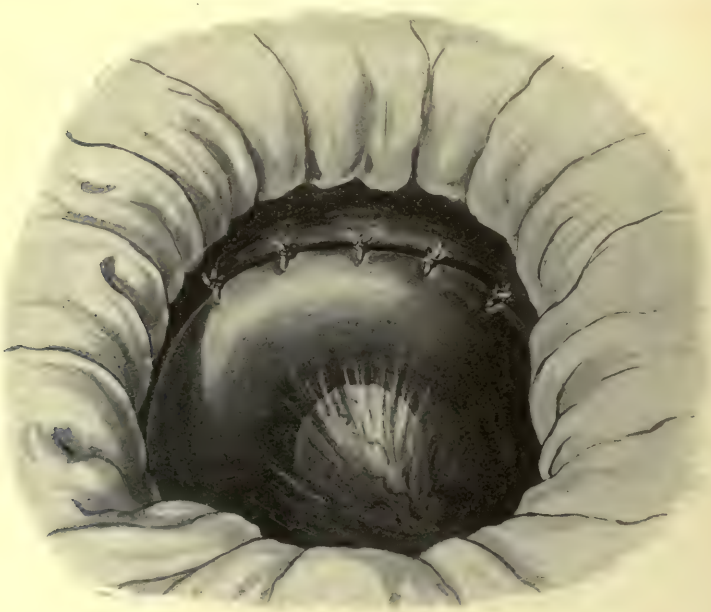

FIG. 100.—ANTERIOR GASTRO-JEJUNOSTOMY. The figure shows the jejunum attached to the anterior surface of the stomach and the 'anti-kinking' sutures inserted after the anastomosis has been completed and the clamps removed. Four or five interrupted sero-muscular stitches are inserted after the jejunum has been arranged so as to lie in a bold curve on the stomach wall.

jejunostomy up to the point at which the jejunum is identified. This structure is examined, and the spot at which its division is to be effected is selected. When the anastomosis is to be on the anterior surface of the stomach, this point will be about twelve inches from the duodeno-jejunal junction. The jejunum is now clamped above and below the proposed site of division of the bowel, at least six inches being left between the clamps, and the contents of the intestine being squeezed out before the clamps are applied. The jejunum is now cut cleanly across transversely to its long axis, or preferably slightly obliquely from above downwards from its convex to its mesenteric border, and the mesentery is also torn

backwards in the direction of this incision for two or three inches. The open end of the proximal loop is now covered up in a sterilised cloth and given to an assistant to hold out of the way during the next stage of the

FIG. 101.—ANTERIOR GASTRO-JEJUNOSTOMY COMBINED WITH JEJUNO-JEJUNOSTOMY. The lateral anastomosis should be well below the gastric opening and near the lower level of the jejunal loop.

operation. This is the implantation of the open end of the efferent or distal loop into an incision on the anterior wall of the stomach made similarly to that for the ordinary anterior gastro-jejunostomy. The sutures are inserted in the same way, beginning with the lower half of the outer sero-muscular suture of fine catgut, continuing with the inner stout

suture uniting all the coats of the stomach and jejunum completely around the orifice, and terminating with the completion of the original sero-muscular suture. Finally, the open end of the proximal loop is uncovered and is implanted into the convex border of the distal loop below the point where it crosses the colon (see Fig. 102), another clamp being placed upon the distal loop below the jejuno-jejunostomy orifice to prevent the intestinal contents escaping through the lateral incision in the intestine. The lateral implantation is done in the same way as the

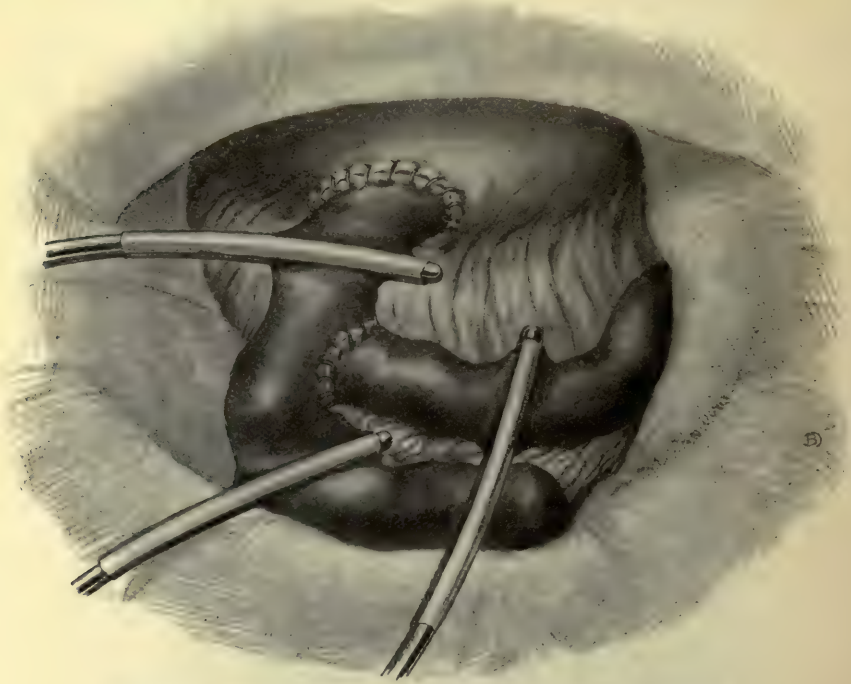

FIG. 102.—ROUX'S Y-OPERATION OF GASTRO-JEJUNOSTOMY. The operation is shown completed, but with the clamps still in position.

gastro-jejunostomy. The clamps are then removed and catgut stitches put into the rent in the mesentery.

Another way of performing the operation is first to perform an anterior gastro-jejunostomy in the ordinary manner (see p. 271) and then to divide the jejunum on the proximal side of the anastomosis and to implant the open proximal end laterally into the small intestine well below the gastro-jejunostomy opening, invaginating and closing the other end. On the whole the first method is probably the better as there is some risk of disturbing the gastro-jejunostomy sutures when dividing and invaginating the open end of the bowel, through which, moreover, it is difficult to prevent the escape of gastric contents.

This operation is absolutely preventive of the extremely grave condition of ' vicious circle,' but it is not applicable in all cases. We would suggest the following as the indications for its use. When there is extensive perigastritis with many adhesions and much deformity of the stomach the surgeon may be unable to apply the intestine to the posterior surface so as to be sure that subsequent kinking cannot occur; and it has even happened to us that secondary kinking has resulted in spite of the most careful suturing at the time of the operation, from the subsequent distortion of the small intestine by the contraction of the perigastric adhesions. A similar remark applies in extensive cancer of the pylorus where the anastomosis has to be made at the extreme left end of the stomach and where therefore kinking is almost certain to occur after the posterior operation. The operation may also be necessary in hour-glass contraction of the stomach where the constriction is so near the cardiac end as to leave only a small surface for anastomosis. Further, it may be necessary in cases in which an ulcer of the stomach is adherent to the pancreas and it is not possible to get at the posterior surface without risk of detaching the adhesions.

Artificial aids to anastomosis.—Simple suture is undoubtedly the best way of making the junction in gastro-jejunostomy. Many ingenious artificial aids have been introduced to facilitate the anastomosis and thus to shorten the length of time taken by the operation, the types of which are Mayo Robson's bobbins and Murphy's buttons. In gastro-jejunostomy, however, these aids are not satisfactory. For end-to-end anastomosis of intestine they may be useful, and the method is described in connection with that operation (see p. 224), but the difficulty of using them for a lateral anastomosis is considerable, quite apart from the fact that they limit the size of the anastomotic opening to a very serious extent.

After-treatment in gastro-jejunostomy.—If the patient is collapsed, continuous rectal infusion of hot saline solution (see Vol. I. p. 115) should be resorted to and an injection of liquor strychninæ (♏x) or of pituitary extract given hypodermically; if the collapse is very severe 1½ pints of sterilised normal saline solution should be run into the axillæ. As soon as the patient has recovered from the anæsthetic, he should be propped up in the 'Fowler position' (see Fig. 91) so as to facilitate the passage of the gastric contents through the artificial opening. The feeding should be conducted on precisely the same lines as after an ordinary gastrotomy (see p. 248). As soon as the anæsthetic vomiting has passed off, the patient may be fed by mouth with semi-solid food, and he may have solid food within a few days provided that it is well broken up. Morphine may be called for during the first forty-eight hours, but should be given sparingly, because it is apt to upset the digestion. Care should be taken to prevent flatulent distension, which is not only painful to the patient, but is also trying to the anastomosis and encourages nausea and vomiting. The best

way to prevent this is by the administration of turpentine enemata and aperients and the frequent use of the flatus tube. By the end of the third week the patient may be allowed to get up and may be considered well. For full details of after-treatment, see p. 209.

Treatment of complications arising after the operation.—Of Bleeding : This is usually the first complication to manifest itself. Occasionally, severe bleeding may occur during the course of the operation itself, but this is always easily arrested by ligature. The most serious form of bleeding met with in connection with this operation occurs within a very short time of the completion of the operation and is due to oozing from an unsecured vessel at the site of anastomosis. There is an impression prevalent that this complication is more common since the introduction of the large clamp for the posterior operation. The clamp prevents any bleeding at the time that the sutures are inserted, but if the inner or hæmostatic suture has been at all carelessly applied, bleeding may occur when the clamp is released, and will not be noticed owing to completion of the anastomosis. The first warning the surgeon generally has is the alarming pallor of the patient, who becomes faint after the operation and vomits large quantities of blood, subsequently also passing altered blood *per rectum*.

This condition is alarming and really dangerous and should not occur if due care be taken over the operation. There is a tendency in some quarters to look upon the operation as one that should be performed with great rapidity, and the natural result of undue hurry is to insert a faulty hæmostatic inner suture. If this suture picks up mucous membrane, submucous tissue, and the sero-muscular coats each time the needle is inserted, if it is evenly spaced and drawn uniformly tightly everywhere as it is introduced, there should be no risk of any recurrent bleeding. To make sure, we always relax the blades of the clamp for a few moments, after the posterior half of the suture has been inserted, and again just before the suture is completed. The surgeon is thus enabled to see at once if his suture has arrested the bleeding or not. If it has not, the bleeding point should be clamped and tied. It is possible that the recent appearance of this complication may be due to the practice of cutting away a considerable quantity of the mucous membrane of the stomach and jejunum. Removal of a small elliptical portion of both is undoubtedly helpful as facilitating accurate suture; but if a large area is excised, the cut edge of the mucous membrane may somewhere retract and may not be taken up in the hæmostatic suture ; bleeding is then very liable to occur.

If the complication occurs, the patient should be placed bolt upright in bed with an ice-bag to the epigastrium, and made to swallow small pieces of ice, so that they may be carried direct to the seat of bleeding. Gallic acid and pil. saponis co., or pil. plumbi c. opio, may be given, and adrenalin chloride may also be tried. Unfortunately the existence of bleeding is usually not discovered until a large quantity of blood has been

lost. It is possible that it might be advisable to open up the wound in very bad cases, but usually it is too late to do so.

Of the 'vicious circle.'—This most important complication calls for immediate and efficient treatment if the patient's life is to be saved. The onset of the mischief is usually marked by persistent vomiting which comes on a short time after the anæsthetic vomiting is recovered from, and is unaccompanied by symptoms of peritonitis.

In the earliest stages of the affection the symptoms may subside after simple *washing out of the stomach* two or three times a day. This acts by removing the gastric contents, checking the peristalsis and allowing the stomach and the afferent loop time to contract. Should the lavage fail, it should not be persisted in for more than a week, otherwise the persistent vomiting will so weaken the patient as to make the chances of a successful result exceedingly remote; early operative interference must be undertaken if the patient is to be saved. The operative procedure depends on the condition present. If it is due to a spur and if the bowel above the anastomotic opening is distended, an anastomosis should be made between the intestine above and below. In the anterior operation there is no difficulty in doing this, nor was there much difficulty in the case of the posterior operation as originally performed, because a loop of jejunum intervened between the duodenum and the opening in the stomach. Should this accident occur with the 'no-loop' method, however, the matter is quite different, and it may be impossible to connect the bowel above and below. If it can be done it is the proper procedure; but if not, there seems to be no alternative but to detach the bowel from the stomach, sew up both openings, and make a fresh posterior junction if the patient is well enough to stand the operation, or else to perform an anterior gastro-jejunostomy or the Y-operation. Fortunately, the 'vicious circle' very seldom occurs after the 'no-loop' operation, but if it does, it is a very formidable complication and will tax the surgeon's ingenuity and skill to the utmost. When the complication occurs from kinks or twists beyond the anastomotic opening, they must be dealt with according to the conditions found, by undoing the kinks, or by jejuno-jejunostomy.

Of contraction of the opening.—This is a later difficulty due to gradual contraction of the anastomotic opening. It is not uncommon when that opening has been made by artificial aids, such as bobbins or buttons, or when the opening after simple suture has been too small, or when the stomach has been much dilated before the operation or when the pylorus is patent. These conditions have been already referred to on p. 263.

When stenosis occurs with recurrence of symptoms, there is nothing for it but to perform a laparotomy, and either to make a fresh anastomosis or enlarge the existing one. Should the original operation have been a posterior gastro-jejunostomy, it is, of course, easy to perform an anterior one at the second sitting. Should the original one have been the anterior operation, however, the surgeon is often faced with a considerable

difficulty. He must either detach the bowel and stomach, sew up the openings, and make an entirely fresh anastomosis by laying some other part of the jejunum upon the anterior wall of the stomach, or he must enlarge the existing opening, which is by no means an easy task.

Gastro-duodenostomy.—Several surgeons—notably Kocher—have advocated gastro-duodenostomy in preference to gastro-jejunostomy in all cases in which it is possible, on the grounds that it affords a more

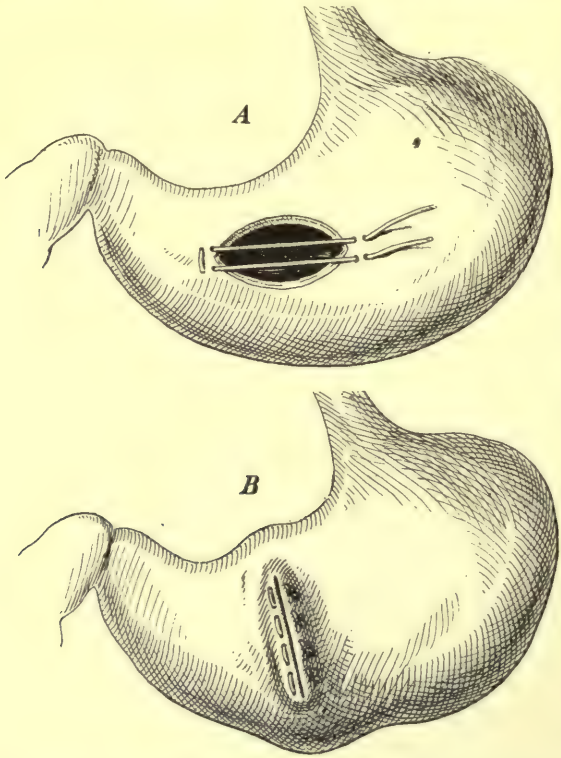

FIG. 103.—METHOD OF PREVENTING NARROWING OF THE STOMACH AFTER EXCISION OF A LARGE GASTRIC ULCER. *A* shows the method of converting an ellipse with its long axis parallel to the curvature of the stomach into a cicatrix at right angles to this by means of mattress sutures. In *B* the row of sutures is inserted preparatory to being buried by a continuous Lembert stitch.

direct exit for the stomach contents and that it avoids the risk of peptic ulcer and the 'vicious circle.' Full details of the operation will be found in Kocher's 'Textbook of Operative Surgery,' 1903 (translated from the 4th German edition by H. J. Stiles), pp. 431 *et seq.* The essential point is to free the descending part of the duodenum sufficiently to enable it to be brought forward to the anterior surface of the stomach. Kocher does this by dividing the peritoneum about two fingers' breadth to the right of the duodenum, curving the incision round below until the vessels supplying the transverse colon are reached, and then lifting forward the

peritoneum and the duodenum sufficiently to enable the anastomosis to be done outside the abdomen by the usual double row of sutures. Whatever advantage this method may eventually prove to have in cicatricial stricture of the pylorus, it seems hardly suitable in malignant disease or where there are extensive adhesions, as in these cases it will obviously be difficult to bring the parts into apposition so as to effect the anastomosis without undue tension.

While one or other of the above operations will be feasible in any case of gastric ulcer of the type described on p. 252, the size and situation of the ulcer may tempt the surgeon to excise it. The following are the main points in performing this operation.

Excision of a gastric ulcer.—The stomach is washed out before the anæsthetic is administered, and the abdomen is opened by a vertical incision a little to the right of the middle line, as already described. If the ulcer is situated on the anterior wall of the stomach, the operation is easy, as the ulcer can be felt through the wall and its presence and size are evident to the eye by the thickening of the peritoneal coat over it. The stomach is drawn well out of the wound and packed off with abdominal cloths, and the ulcer is excised by enclosing its base in an elliptical incision, which, if possible, should have its long axis at right angles to that of the stomach. An incision in this direction will divide fewer vessels and will not diminish the transverse diameter of the organ when sewn up. The ulcer should be cut away rapidly with sharp curved scissors, the edges of the incision being seized in catch-forceps meanwhile and held well up so as to prevent the escape of any gastric contents not removed by the preliminary lavage. As a rule the bleeding following excision is not severe ; it is greatest when the ulcer lies near either of the curvatures, as one of the larger vessels may then be cut across. It is easy to seize and tie any spurting vessel, and the bleeding may always be stopped temporarily by compressing the edge of the incision with forceps or between the finger and thumb. Any oozing that remains is checked by sewing up the stomach precisely as in the operation for rupture of that organ (see p. 243).

Should the area of the stomach excised be considerable, there may be some tension on the edges of the wound, and under these circumstances mattress sutures (see Fig. 87) should be used for the deep layer, these being buried by a superficial continuous Lembert suture. In an easily accessible organ like the stomach, the sutures are readily inserted by using a straight round needle which requires no needle-holder.

It is important to see that there is no constriction of the lumen of the organ as a result of the operation. If a considerable portion of the wall of the stomach is removed and the wound is sewn up in a longitudinal direction, there may be marked contraction of the lumen of the organ and a condition of ' hour-glass contraction ' may even be produced. This is avoided by suturing the wound so as to make the scar vertical (see Fig. 103) ;

by doing this the vertical measurement of the stomach may actually be increased so that, even allowing for some contraction subsequently, the sectional lumen of the viscus will not be diminished.

When the ulcer is not excised, but the base is thinned and perforation is probable, it should be infolded by a series of Lembert's sutures—as is done in some cases of perforated or actively bleeding ulcers (see p. 286)—and a gastro-jejunostomy performed, the pylorus being narrowed by stitches if it is not already contracted.

TREATMENT OF ACTIVE GASTRIC HÆMORRHAGE.

The surgeon is not infrequently called in to treat this condition. In connection with operation under these circumstances, it is well to bear in mind that bleeding in cases of gastric ulcer is very rarely fatal *per se*, however profuse it may be for the moment, and that most cases of active hæmorrhage from a gastric ulcer can be checked by purely medical means and the bleeding does not necessarily recur. Further, if the hæmorrhage is severe enough to endanger the patient's life, this danger will be enormously increased by operative interference, and the resulting shock may be sufficient to bring about a fatal termination. Lastly it may be by no means easy to find the source of hæmorrhage, or to treat it appropriately when found.

The source of the hæmorrhage may vary considerably. Thus it may come from large vessels such as the coronary or gastro-epiploic arteries, or only a small branch may be involved. On the other hand, the bleeding may not be derived from any large vessel at all, but may come from superficial erosions of the mucous membrane, the oozing from which is exceedingly difficult to check. We therefore recommend that operative interference should only be undertaken on account of hæmorrhage pure and simple, when the bleeding is so severe as to threaten the patient's life if it continues any longer, and only after attempts to check it by medical measures have proved unavailing.

In all cases of active hæmorrhage from the stomach the patient should be confined to bed in the strictly horizontal position. The head should be kept low and a large ice-bag placed over the epigastrium. Ice may be given freely by the mouth and the patient should be kept quiet, and friends and relatives should not be allowed to see him. While the hæmorrhage is active, ergotinine citrate (gr. $\frac{1}{50}$) may be injected subcutaneously, combined with morphine ; these may be frequently repeated, and pil. saponis co. (gr. iij) may be given every four hours followed by gallic acid in ten-grain doses as the bleeding diminishes. Supra-renal extract is valuable in doses of five minims every three or four hours. Irrigation of the stomach with iced water may also be employed, a soft tube being used and great care exercised both in passing it and in performing the

irrigation not to damage the stomach wall or to over-distend the organ. This is especially useful when the stomach is distended with clot. Works on medicine must be consulted for further details of the non-surgical treatment of gastric hæmorrhage.

Operation.—When it is determined to open the stomach to arrest the bleeding, the most stringent precautions must be taken against shock (see Vol. I. p. 118) and all the stages of the operation must be carried out with the greatest rapidity consistent with safety. The abdomen is opened by the usual vertical incision (see p. 215) and the anterior surface and greater curvature of the stomach are examined both by sight and by touch; the first part of the duodenum should also be inspected. A chronic ulcer on the anterior surface of the stomach or in the neighbourhood of one of the curvatures is readily detected by the alteration in the peritoneal coat, by the induration around it, and by the loss of substance over the ulcer, which can be felt by the finger. If an ulcer is found on the anterior surface it is treated in the manner described on p. 279.

In the majority of cases the ulcers which give rise to free hæmorrhage are either on the posterior wall or towards one end of the stomach, and if the whereabouts of the ulcer is difficult to make out, an incision should be made into the stomach three or four inches in length parallel to the two curvatures and rather nearer the greater than the lesser. Immediately this is done, the ends of the incision and the central points on each side should be seized in volsella forceps, which are raised by assistants so that a large lozenge-shaped opening is formed, which allows the passage of the hand. The organ is then rapidly emptied of its contents, which mainly consist of blood. If the bleeding is coming from a large vessel, it can often be seen spouting as soon as the gastric contents have been removed, and it must be compressed at once by a sponge held in long forceps, while the surgeon decides how to deal with it. If no spouting vessel is seen, the entire mucous membrane must be methodically examined, beginning with the anterior suface, which can be easily inspected by everting it through the opening and sponging each portion carefully as it is brought into view.

If no ulcer can be seen on the posterior surface from the incision in the anterior wall, a hole may be made in the greater omentum sufficiently large for the assistant or the operator to introduce a hand along the posterior wall of the stomach, and push the mucous membrane up to or through the opening in the anterior wall (see Fig. 104). This is easy if there are no adhesions fixing the posterior surface, and in this way the entire posterior wall may be examined. If no ulcer or bleeding point is found in this situation the finger should be pushed through the pyloric opening which, if of normal calibre, should admit it freely; if it be too contracted to admit the finger or if an ulcer be felt in that situation, the incision in the anterior wall may either be prolonged up to the pylorus,

or, if the patient's condition is bad, an anterior gastro-jejunostomy may be done (see p. 271).

If this examination fails to reveal an ulcer, the cardiac end should be inspected by pulling up the liver and the costal margin, introducing a large broad retractor into the stomach, and projecting a strong light into the interior of the organ. It saves much time to perform explorations of the stomach in this methodical manner if the ulcer is not evident at once. In many cases, however, the ulcer can be seen directly the

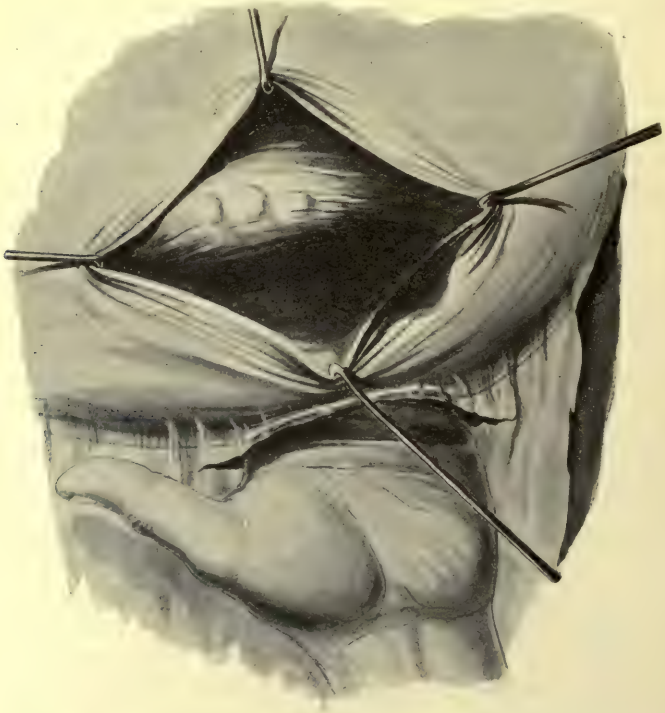

FIG. 104.—METHOD OF EXAMINING THE MUCOUS MEMBRANE OF THE POSTERIOR GASTRIC WALL THROUGH AN INCISON IN THE ANTERIOR WALL. The hand introduced through a slit in the omentum pushes up and protrudes the posterior wall through the opening.

stomach has been emptied—the hard, ulcerated surface may be felt, and the source of the bleeding may be made out by the spouting of blood from a vessel or by watching the direction from which the blood trickles. The methodical examination of the mucous membrane is particularly necessary in the case of superficial ulcers or erosions which bleed freely, but which give rise to no induration and cannot therefore be felt.

Treatment.—*Should the ulcer be on the anterior surface* and not adherent to adjacent structures, the best method of arresting the hæmorrhage is

to excise the ulcer if the conditions are suitable, and this is done in the manner described on p. 279.

When the ulcer is situated on the greater curvature, the bleeding will come from one of the gastro-epiploic vessels, and it can be quickly arrested by clamping the main vessel externally on each side of the site of the ulcer ; the latter is then excised if the conditions permit (see p. 279) along with any indurated portion of the omentum about its base. The incision through the omentum should be triangular in shape with its apex downwards and its base corresponding to the ulcer on the curvature (see Fig. 105). When the opening in the stomach has been sutured,

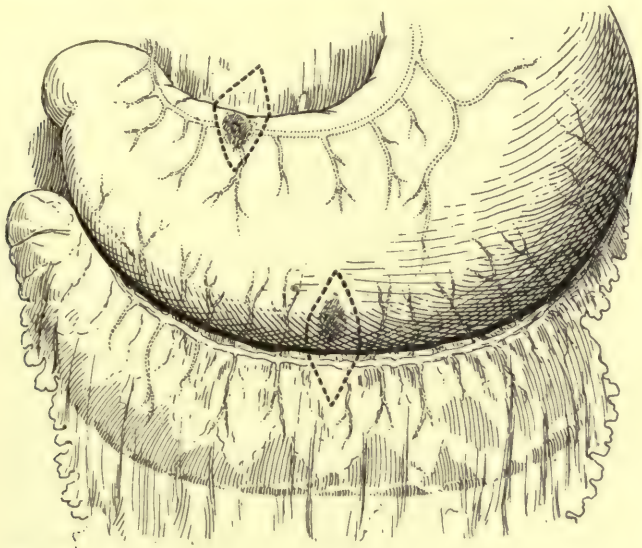

FIG. 105.—METHODS OF TREATING ULCERS SITUATED AT THE CURVATURES OF THE STOMACH. The shaded areas indicate the position of the ulcers, and the dotted lines are the lines for excising them. These are partly through the stomach walls and partly through the omenta. By their means it is possible to bring the divided edges together without difficulty.

one or two stitches will suffice to close the opening in the omentum. It may, however, happen that the induration is so extensive that excision of the ulcer is impossible, and under these circumstances, ligature of the gastro-epiploic artery alone will usually suffice to stop the bleeding. This may be done by passing an aneurysm needle around it or by underrunning it with a needle threaded with catgut. In the case of an ulcer on the lesser curvature the coronary artery should be dealt with in a similar manner.

When the ulcer is situated on the posterior surface and is adherent to the pancreas, as is not infrequently the case, a large pancreatico-duodenal vessel may be opened, and free and even fatal hæmorrhage may result. Under these circumstances the spouting vessel will generally be seen when

the stomach is opened and can be stopped temporarily by pressure until the stomach contents have been evacuated. The difficulty is to treat the ulcer. Attempts have been made to excise it by introducing the hand along the posterior gastric wall through a slit in the omentum and gradually separating the ulcer from the pancreas, but the adhesions are generally too extensive and, further, the patient's condition is probably so bad that speed is of urgent importance. Under these circumstances one or other of the following measures may be adopted—namely, to pick up the vessel and tie it ; to arrest the bleeding by the actual cautery ; to underrun the bleeding vessel with stout catgut and tie it and a portion of the pancreas *en masse* ; or to pass stitches through each side of the ulcer and tie them tightly so as to block the orifice of the vessel. The last plan is the best in the majority of cases.

When the hæmorrhage comes from an ulcer of the pylorus or the first part of the duodenum, the simplest plan is to perform a gastro-jejunostomy. The patient will certainly not be in a condition for excision of the ulcer either alone or combined with excision of the pylorus, and unless there is actual erosion of a considerable vessel, the bleeding will stop when the gastric contents cease to pass over the ulcerated surface.

When the bleeding is the result of very free oozing from the mucous membrane or when no bleeding point can be found, a gastro-jejunostomy will usually suffice. The cautery applied at a dull red heat to a simple erosion will sometimes check the bleeding from it, but usually the best plan is to swab over the oozing surface with adrenalin chloride (1 in 1000) or five minims of supra-renal extract in a little water, and then to perform a gastro-jejunostomy. Some supra-renal solution may be introduced and left in the stomach while the anastomosis is being made.

From the nature of things it cannot be expected that the rôle of surgical intervention for the purpose of saving a life imperilled by severe bleeding is likely to be a very brilliant one, as the condition of the patient must necessarily be so unsatisfactory. Indirectly, however, hæmorrhage is treated by surgical means with great success in cases in which the bleedings are small and repeated and threaten, if allowed to persist, to endanger the patient's life. These cases really fall under the first group already described (see p. 256). When called upon to interfere for active hæmorrhage, the surgeon will nearly always find that the bleeding has been checked by medical means, but that the hæmorrhages have been so free and so often repeated that something must be done to stop them permanently. Under these circumstances it is best to wait for a short time, if possible, until the patient has to some extent recovered from the immediate loss of blood ; but if the hæmorrhages are repeated daily or every few days this is not permissible, and excision of the ulcer, gastro-jejunostomy, or both, must be practised immediately.

TREATMENT OF PERFORATED GASTRIC ULCER.

The symptoms of perforation of a gastric ulcer are not always constant or typical. In their most characteristic form they consist of sudden acute localised pain, accompanied by exquisite tenderness and local rigidity of the abdominal wall. This is followed rapidly by collapse, vomiting, and diffusion of the pain with tenderness and rigidity over the whole abdomen. There may be loss of liver dullness indicating free gas in the abdomen, and if the perforation is large and the amount extravasated great, there will be dullness in the flanks from the accumulation of fluid.

In something like 80 per cent. of these cases the perforated ulcer lies on the anterior wall of the stomach. The perforation is usually a minute aperture in the peritoneal coat over the base of the ulcer; sometimes, however, it may be of considerable size. An ulcer situated anywhere on the stomach may perforate, but when this occurs through the posterior wall, or when adhesions have so shut off the general peritoneal cavity that no extravasation takes place into it, the symptoms may be extremely slight.

When a gastric ulcer perforates into the abdominal cavity, it gives rise to either local or general peritonitis. When the opening is fairly large and there are no adhesions, general peritonitis sets in, and the condition is practically always fatal if left alone. In some cases, however, sufficient adhesions are present to shut off the surface of the stomach from the general abdominal cavity, and under these circumstances there is only a localised peritonitis, which practically always ends in suppuration and gives rise to a subphrenic abscess (see Chap. XXVI.). In some cases a small amount may trickle down into the pelvis and give rise to a pelvic abscess.

When perforation into the general peritoneal cavity has occurred, it is clear that the only chance for the patient is an immediate operation designed on the one hand to close the opening in the stomach and on the other to remove the gastric contents from the peritoneal cavity. The success of this operation depends to a great extent on the length of time that has elapsed between the occurrence of the perforation and the performance of the laparotomy. After the first twelve hours the mortality increases enormously, and very few cases recover in which general peritonitis has set in. Hence, if there be any doubt as to the occurrence of a perforation, it is far better to open the abdomen early than to wait until the diagnosis is placed beyond doubt by the development of peritonitis.

Preliminaries.—The shock is very often intense, and measures must be adopted for combating it (see Vol. I. p. 118). The anæsthetic employed should be ether, and if the patient's condition be very bad it may be well to employ the intravenous method (see p. 32). The skin should be purified as rapidly as possible and the abdomen opened

by a free incision from the xiphoid cartilage to the left of the umbilicus in the manner already described (see p. 32). The peritoneum must be opened with care as there may be adhesions between an ulcer on the anterior wall of the stomach and the parietes.

Finding the perforation.—The diagnosis is usually confirmed immediately the abdomen has been opened, by the escape of gas and sour-smelling gastric contents. Whether this be so or not, the incision is widely retracted, abdominal cloths are packed in, especially at the lower angle and sides of the wound; and the stomach is drawn gently out of the wound and packed behind with other abdominal cloths. As the ulcer is on the anterior wall in the majority of cases, it is seen without any difficulty; if, however, it is not evident, the pyloric region and the first part of the duodenum should be next examined and, failing that, the cardiac end of the stomach. As a rule the seat of the ulcer is easily detected, as slight pressure on the abdomen or the stomach causes gas to bubble out at the opening; this bubbling can be both heard and seen.

Should no ulcer be found on the anterior surface, the posterior wall of the stomach is examined in the way described on p. 281. In this situation extravasation is uncommon, and if it does occur, it is generally into the lesser cavity of the peritoneum, which becomes shut off from the general peritoneal cavity. If left, suppuration occurs and an abscess forms which may spread in various directions, most commonly in the subphrenic region; this must be opened and drained. The treatment of subphrenic abscess is dealt with in Chap. XXVI.

Closure of the perforation in the stomach.—Attention is next directed to the closure of the perforation in the stomach. Theoretically, the simplest plan is to invaginate the stomach wall over the area of the ulcer and to suture the opposing surfaces with one or more continuous sero-muscular sutures. This is often difficult, however, as there is much induration around the edge of the ulcer; but if the stitches are passed far enough away from the perforation it can usually be closed, and if an excessive degree of narrowing is produced gastro-jejunostomy should be performed. In other cases it will be better to excise the ulcer, especially if it is of limited extent.

In the rare cases in which the ulcer is very large and its walls so dense and thickened that they can neither be inverted nor safely excised, it has been proposed to close the opening by turning up a portion of the omentum and fastening it over the base of the perforated ulcer with catgut stitches. To this should be added a gastro-jejunostomy (see p. 265), if the patient be in a condition to bear it; this may be rapidly done, and will give the patient a good chance of recovery. This plastic method of covering up the perforation with a portion of omentum is also particularly applicable to ulcers in the neighbourhood of the first part of the duodenum; in some cases the gall-bladder has been stitched over the opening.

If the perforation is on the posterior surface of the stomach, it should be either sewn up or excised. Excision, however, can only rarely be carried out owing to the connections of the ulcer, and closing the opening from the outside may also be very difficult ; indeed, in some cases the best plan will be to open the stomach in front and bring together the sides of the ulcer in the manner referred to in speaking of the treatment of hæmorrhage in this situation (see p. 283). If this is done, drainage tubes must be inserted down to the situation of the ulcer in case union does not take place.

Cleansing the abdominal cavity.—This must be done systematically, and the steps of the procedure are exactly similar to those for rupture of the stomach (see p. 243). It is of the highest importance that this stage of the operation should be carried out with the greatest thoroughness.

Drainage—In closing the abdomen the question of drainage will arise, and here the remarks made in reference to rupture of the stomach (see p. 247) are also applicable. It is always advisable to insert a drainage tube down to the immediate vicinity of the ulcer in these cases, as it is possible that the line of union may give way and further extravasation may take place. The best plan is to employ a drainage tube packed round with gauze. The latter need only be left in for three days, as adhesions form rapidly and shut off the region that is to be drained from the rest of the peritoneal cavity. The gauze may be removed by saturating it with a solution of peroxide of hydrogen (10 vols.) which loosens it from the surrounding peritoneum. It must be removed gradually and by gentle traction.

After-treatment.—This will be identical with that for rupture of the stomach (see p. 248). The drainage tube is withdrawn at the end of three or four days if no unfavourable symptoms arise, and if the wound is aseptic, the opening in the abdominal wall through which it has passed may be closed by tying the loose stitch which was inserted but not tied at the time of the operation (see p. 249).

The question of gastro-jejunostomy.—Much discussion has taken place as to whether a gastro-jejunostomy should be performed at the same time as the perforation is closed, and very diverse opinions are held on this subject. In favour of this operation, it is said that it relieves the tension on the stitches which close the perforation, diminishes the risk of subsequent perforation and hæmorrhage, and helps the healing. Against it may be urged that it prolongs the operation, and that it can be done if necessary at a later period. Experience seems to show that perforations heal up quite well if they are closed with stitches without gastro-jejunostomy, and that except in cases where the removal of the ulcer or closure of the perforation narrows the pyloric part of the stomach markedly, there is no advantage in performing the operation at this stage ; indeed, it might just turn the scale against recovery. In most cases the operation can be deferred until a later period.

TREATMENT OF CONTRACTIONS AND ADHESIONS OCCURRING IN CONNECTION WITH A GASTRIC ULCER.

Here the surgeon has to treat not the ulcer itself, but its sequelæ, for the ulcer may have healed and the patient's symptoms be caused entirely by the cicatricial contraction consequent upon this. Various conditions may require remedy ; stenosis of the pylorus may occur, or there may be constriction of the stomach itself, which usually takes the form known as ' hour-glass contraction.' Besides this there may have been extensive perigastritis leading to adhesions between the stomach and one or more of the adjacent viscera. It will be best to describe the treatment of each of these conditions separately although more than one of them may be met with at the same time.

TREATMENT OF STENOSIS OF THE PYLORUS.

A method of treatment which was formerly much practised and is still employed under certain circumstances is that introduced by Loreta ; he forcibly dilated the pyloric orifice with instruments or with the finger passed through it from an opening in the stomach until the lumen had been dilated as much as possible without splitting the peritoneal coat. Loreta's operation has not fulfilled the hopes entertained of it ; experience shows that contraction is apt to recur, and in a short time the patient's condition is as bad as ever. Accidents have also happened, such as splitting of the cicatricial tissue and perforation into the peritoneal cavity, and the operation has now been abandoned in cases of cicatricial stenosis. At the present time the surgeon makes his choice between the operations of pyloroplasty and short-circuiting ; gastro-duodenostomy may be done in some cases, but gastro-jejunostomy is the usual form of short-circuit operation. Pylorectomy has also been performed for this condition, but it is a much more severe operation than any of the others, and in these particular cases it is especially difficult and dangerous, because of the adhesions in the neighbourhood of the pyloric orifice. We do not therefore advise the operation for a simple stricture of the pylorus.

Pyloroplasty.—Pyloroplasty is certainly suited for some cases of narrow annular stricture, but as a rule subsequent contraction takes place which may lead to recurrence of the symptoms.

We should limit this operation to cases of dilatation of the stomach due to narrowing of the pylorus where there are no adhesions, no marked thickening of its walls, and no atony of the stomach. The principle of the operation is to make a free longitudinal incision from the stomach to the duodenum, dividing the pylorus along its long axis, and then to approximate the two ends of this incision so as to convert it into a transverse

one, thereby increasing the vertical diameter of the pyloric ring (see Fig. 106).

The abdomen is opened slightly to the right of the middle line in the usual manner (see p. 215) and the pylorus brought as far up into the wound as possible and packed off with abdominal cloths. An intestinal clamp is applied to the duodenum as far on the distal side of the proposed

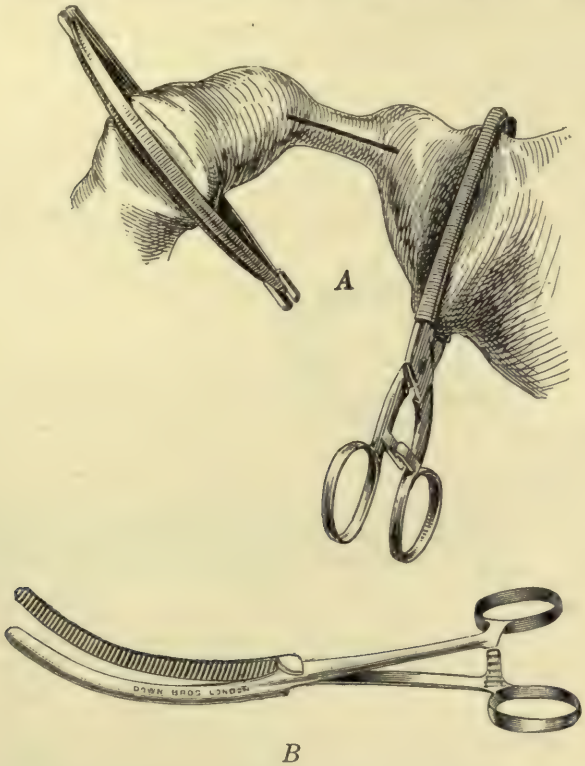

FIG. 106.—PYLOROPLASTY. In *A* is shown the method of clamping the duodenum by a Lane's clamp—which is shown in more detail in Fig. 107—on the left-hand, and the stomach by rubber-sheathed forceps on the right-hand side; these forceps are shown in *B*. The longitudinal incision is marked out along the narrowed pylorus, and this incision is converted into one that has its long axis at right angles to that of the pylorus by a mattress suture. The row of mattress sutures is buried by a continuous sero-muscular stitch. The calibre of the pylorus is relatively much enlarged.

incision as possible, the loop of bowel being squeezed empty of its contents before it is applied. The pyloric end of the stomach should also be clamped (see Fig. 106). An incision is then made in the anterior wall of the stomach about half an inch from the pylorus, and carried horizontally through that structure for about half an inch on to the duodenum. If there is much contraction it may be difficult to hit off the passage through the pylorus, and under these circumstances it is best to open the stomach just in front of the pylorus, then pass a probe through the latter into the

duodenum and cut down upon this as a guide; if preferred, a pair of probe-pointed scissors may be used to slit up the pylorus. A mattress suture (see Fig. 87) is inserted at each end of this incision, and when this is tied, what were formerly the ends of the incision become the central points and the line of incision is converted from a horizontal into a vertical one (see Fig. 106). This suture should be of silk, and should be reinforced by two others on each side, so that the edges of the incision are brought together throughout; the operation is completed by burying these sutures with a continuous sero-muscular suture of fine catgut. The area of operation is then cleansed, the abdominal cloths are removed, and the abdomen closed in the usual manner (see p. 215).

Gastro-jejunostomy is called for when there is much cicatricial tissue which would necessitate a long incision, thus rendering the approximation of the edges of the wound by pyloroplasty difficult. The

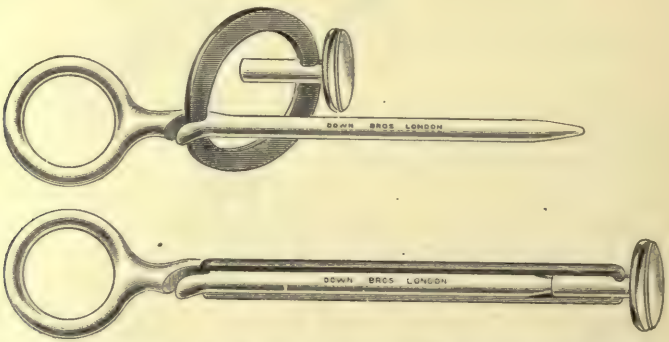

FIG. 107.—LANE'S INTESTINAL CLAMPS. A very useful type of clamp when the bowel has not a long mesentery, as it is easy to push the metal stem behind the bowel in any position. The rubber is stretched across the front of the bowel and effectually but lightly compressed. The sketch is full size.

posterior operation (see p. 265) should be chosen, and if the opening is made sufficiently large, the result is satisfactory. In some cases, however, the stomach is so bound down that an anterior gastro-jejunostomy is preferable.

Gastro-duodenostomy or the anastomosis of the duodenum with the stomach, is suitable for cases in which the adhesions are not too extensive to prevent the descending portion of the duodenum being freed and brought over to the anterior surface of the stomach (see p. 278).

TREATMENT OF 'HOUR-GLASS CONTRACTION.'

For the treatment of this condition the surgeon has at his disposal the operations of gastroplasty, gastro-gastrostomy, or gastro-jejunostomy.

Gastroplasty.—This operation can only be done when the constriction between the two portions of the stomach is the chief mischief

and is not accompanied by extensive induration or distortion of the surrounding stomach wall. An incision is made in the anterior wall of the stomach parallel to the curvatures, extending at least an inch beyond each end of the constriction. The incision is carried into the interior of the stomach just beyond one end of the stricture, and the constriction is divided by pushing either a probe-pointed bistoury or one blade of a pair

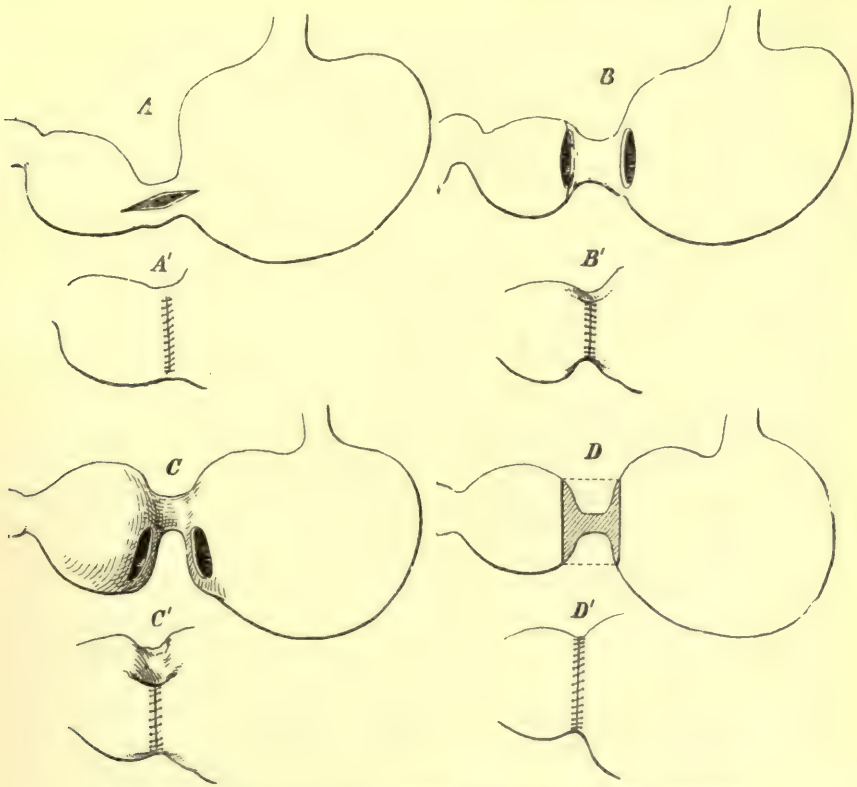

FIG. 108.—METHODS OF TREATING AN 'HOUR-GLASS CONTRACTION' OF THE STOMACH. *A* and *A'* show the two stages of gastroplasty, *B*, *B'* and *C*, *C'* the stages of gastro-gastrostomy under different conditions, while *D*, *D'* shows partial gastrectomy combined with subsequent gastro-gastrostomy, the shaded portion being the part excised.

of probe-pointed scissors along the narrow portion so as to divide the stricture throughout. This longitudinal incision is now converted into a transverse one by approximating the ends of the incision with sutures of silk (see p. 278); if there is little tension, but fairly free oozing, a continuous stitch taking up all the coats of the stomach may then be inserted, but should the tension be considerable, mattress sutures should be used. Outside the first line of sutures a continuous sero-muscular suture of fine catgut completes the closure (see Fig. 108, *A*).

This operation may fail for two reasons. In the first place the artificial opening thus made diminishes in size as the cicatrix contracts, and recurrence of the stricture takes place. In the second place adhesions are very likely to form as the result of the manipulations about the stomach and this may subsequently interfere with the functional result. The first difficulty can be met to a considerable extent by making the incision into the stomach long enough to give a wide opening and allow for the subsequent contraction. The second can only be met by performing the operation as quickly as possible and by taking care that the surface of the organ is not irritated mechanically or chemically.

Gastro-gastrostomy.—When the stomach is divided into two large and distinct sacs the operation of gastro-gastrostomy has been performed (see Fig. 108). In this the actual constriction is left alone and the dilated portions on either side are united by an ordinary lateral anastomosis, usually below or in front of the seat of constriction. The anastomosis is made by simple suture, and a glance at Fig. 108, *B*, will explain its mechanism. The operation is really not very satisfactory and is only of use when the constriction is merely a part of extensive distortion of the walls of the stomach which renders it impossible to perform a satisfactory gastroplasty.

Partial gastrectomy.—It has been proposed that, when the distal portion of the constricted stomach is very small, a partial gastrectomy should be performed, the small distal portion of the stomach being removed and the end of the duodenum implanted into the part left behind (see p. 307). This is a severe operation and offers no particular advantages over other methods. When the constriction is in the middle and there is much induration, the whole constricted area may be excised and the two halves of the stomach reunited (see Fig. 108, *D*). This suggestion should be borne in mind, especially when the proximal sac is the smaller of the two.

Gastro-jejunostomy.—This operation is very useful, but, as it puts out of use the distal portion of the stomach, it should not be performed except when the stricture is near the pyloric end, and when one or other of the procedures already referred to is not applicable. It will chiefly be employed for the cases in which the surface of the stomach is markedly deformed by adhesions from perigastritis due to extensive or multiple ulcers. Plastic operations upon the stomach under these circumstances are not satisfactory.

With regard to the question of gastro-jejunostomy, it is well to remark that it has happened more than once that the anastomosis has been made between the distal portion of the stomach and the jejunum instead of between the latter and the proximal sac. This is particularly likely to occur when the constriction of the stomach is near the cardiac end, and the result is of course that the patient obtains no relief. Consequently the surgeon must make quite certain of the topography of the stomach and

must not mistake a somewhat constricted pylorus for an 'hour-glass contraction' of the stomach; the pyloric vein is a very important mark by which to identify the pylorus. This accident has occurred in the hands of competent surgeons, and it has also happened that a pyloroplasty instead of a gastroplasty has been performed with the result that the actual constriction has been unrelieved.

TREATMENT OF SYMPTOMS DUE TO GASTRIC ADHESIONS.

The surgeon is not infrequently consulted when the history points to the previous existence of a gastric ulcer, but when the existing symptoms take the form of dyspepsia with much pain or distension after meals, constipation, etc. If these symptoms cannot be remedied by appropriate medical treatment, the surgeon may decide to perform an exploratory laparotomy, and will then often find that the symptoms are due to old perigastritis which has led to the formation of adhesions which either partially obstruct the stomach or attach it to the liver, the gall-bladder, or the transverse colon, or transform the greater part of the stomach into a hard, 'leather-bottle'-like organ. We have already considered the more marked and limited adhesions causing stenosis of the pylorus and 'hour-glass contraction' of the stomach. Those to which we refer here are of a different character and do not produce any actual narrowing of the cavity of the stomach. Their effect is to give rise to uneasy feelings and disturbances after food or on movement of the intestines, owing to the fact that they anchor the organ to adjacent parts. Quite a number of cases of apparently confirmed dyspepsia have been improved or even entirely cured by opening the abdomen and finding and dividing adhesions of this kind, or by performing gastro-jejunostomy when there is no other method of relieving the gastric stasis.

The operation takes the form of an exploratory laparotomy; any adhesions present are separated, and the stomach is freed in any manner that may seem necessary. Sometimes the adhesions take the form of long, thin bands crossing from the stomach to the liver and preventing descent of the stomach when it is distended. Sometimes they pass between the stomach and the colon; sometimes the stomach, liver, and colon are all united by a thick fibrous band. These bands may become stretched in time and form cords, which are a constant potential cause of intestinal obstruction. When this condition is found, the proper treatment is to remove as much of the bands as possible; it is not advisable simply to divide the bands and leave the ends free, as they may contract fresh adhesions and become a source of trouble a second time. They should be divided if possible at their extreme points of attachment and the whole of the intermediate portion removed. Many of the adhesions will require ligature before they are divided. In cases of long narrow bands the operation should effect a complete cure.

In other cases, extensive broad adhesions are met with which are much more difficult to separate, and when separated, large raw surfaces are left behind that are unfortunately only too prone to contract fresh adhesions. These cases are often extremely disappointing; the immediate results may be very brilliant, but, as time goes on, the old symptoms gradually reappear as the fresh adhesions contract. At the same time the operation is always worth doing because the adhesions may not re-form in exactly the same way, and the troublesome symptoms may be relieved. It is well during healing to try, by putting the patient into suitable positions, to prevent recurrence of the same sort of adhesions as before. For example, if the stomach and colon are tucked up under the liver, the patient should be propped up in bed as soon as possible after the operation, so that the stomach falls downwards, or if necessary he may actually sit up or lie upon one side. Particular care must of course be taken under such circumstances to secure thorough stitching of the abdominal wall. The actual management of these cases cannot be described in detail as everything depends upon the particular conditions met with. In all operations for adhesions special care is necessary to manipulate the abdominal cavity as little as possible and avoid giving any cause for fresh adhesions. Many surgeons now make it a practice to steep their abdominal cloths or the sterile gauze used for packing aside the intestines in some sterilised bland substance, such as vaseline or pure paraffin, in order to make sure that no mechanical irritation of the parts occurs. This precaution is a good one, as the mere contact of a cloth with the peritoneal coat of the bowel for quite a short time leads to effusion of lymph and subsequent adhesion of the two structures. Sterilised vaseline may also be smeared over the raw surfaces to prevent them sticking together immediately after the operation.

CHAPTER XVIII.

CONGENITAL HYPERTROPHIC STENOSIS OF THE PYLORUS: NON-OBSTRUCTIVE DILATATION OF THE STOMACH.

CONGENITAL HYPERTROPHIC STENOSIS OF THE PYLORUS.

This condition has come into considerable prominence during the last few years. It is an affection of early infancy characterised by obstruction to the passage of the contents of the stomach into the duodenum owing to an increase in the thickness of the pylorus. The exact cause of this increase is not known, but the result is that the pyloric ring shows itself as a dense whitish cylinder closely resembling a small decalcified bone bobbin and sometimes measuring an inch or even more in diameter. It feels like cartilage, and although it relaxes somewhat from time to time, especially under anæsthesia, it is always abnormally hard and unduly contracted.

The effect of this is to give rise to narrowing of the pyloric outlet, and as a result the stomach becomes dilated and its walls considerably hypertrophied. The enlarged pylorus forms a tumour that can be felt through the abdominal walls, and the hypertrophied and dilated stomach gives rise to a visible peristaltic wave in its efforts to empty itself.

The *symptoms* of this affection may set in immediately after birth or their onset may be delayed for a fortnight or longer. Occasionally the onset of symptoms coincides with the substitution of artificial food for breast-feeding, but in many cases they arise during suckling. The child begins to vomit, becomes peevish and pinched in appearance, and loses weight rapidly. The vomiting usually occurs only twice or three times a day and is forcible, and the vomit consists of the contents of a dilated stomach. Peristaltic waves are seen travelling across the stomach wall from left to right, especially after food, and careful deep palpation may detect the enlarged pylorus sometimes high up beneath the liver, but more usually at or below the level of the umbilicus

and to its right side. When vomiting and wasting are combined with visible peristalsis and the presence of an enlarged pylorus the diagnosis is certain. The mistake generally made is to look upon the case as one of simple marasmus. If the condition is unrecognised or comes under treatment too late, the child continues to vomit and waste, convulsions set in, and death occurs from exhaustion.

TREATMENT.—The experience of our colleague, Professor G. F. Still, and others, seems to show that much may be done by purely medical treatment if the case is taken in hand early enough; and it seems probable that, in future, surgical intervention will be reserved for the cases which come under notice too late for medical treatment and for those in which medical treatment fails, and consequently the results of surgical treatment will apparently be less favourable than formerly.

(*a*) **Medical.**—In all cases this should be given a fair trial in the first instance, for experience shows that a number of cases are cured by it alone. The essential point in the medical treatment is frequent lavage of the stomach, and with this should be combined the administration of previously digested food and, if necessary, rectal feeding. If the patient is very wasted, and particularly if surgical intervention is likely to be required, subcutaneous infusions of normal saline solution may also be employed.

The *lavage* of the stomach is an easy matter. The child soon gets used to it and does not resent it; indeed, the relief gained is very noticeable. It should be done at least once daily, and oftener if the distention and discomfort seem to demand it. It is effected by means of a No. 10 Jaques's red-rubber catheter and a glass funnel, the fluid used being warm water containing a little bicarbonate of soda or boric lotion. About two ounces of fluid are introduced at a time and then syphoned off, and the process repeated until all curd has been washed out of the stomach. If the catheter be lubricated with a little glycerine, the child will swallow it readily and suck at it contentedly throughout the operation.

The *food* should always be given in small quantities—two to four drams at a time—and it is well to peptonise it. White wine whey, and raw meat juice or very weak peptonised milk are favourite foods in the practice of Professor Still. Food should be given every hour or two according to the child's condition.

Only in bad cases will it be necessary to have recourse to *rectal feeding*. When the vomiting is intractable it may be used as a preliminary to surgical intervention. Each enema should consist of about two ounces of peptonised milk with a few drops of brandy, and may be given every four hours.

Subcutaneous saline infusions may be called for if the child is very ill, and are specially useful as a preliminary to operation. The infusion may be made with a hollow needle connected by rubber tubing with a funnel through which four to six ounces of sterilised salt solution at the body

temperature are run slowly into the subcutaneous tissues of the axilla, groin, or abdomen.

During the treatment, the child must be kept warm and free from draughts and a daily record of the weight charted. Medical treatment should be persisted in as long as there is a gain in weight or, at any rate, no progressive loss. A steady progressive loss of weight should be looked upon as an indication for surgical interference.

These children are liable to gastro-intestinal disturbance after they begin to retain the food by mouth, and several have died from severe diarrhœa after the pyloric trouble had apparently disappeared.

(*b*) **Surgical.** There are three methods of surgical treatment that may be considered. Hitherto we have employed divulsion of the pylorus (Loreta's operation) in all cases. Other surgeons, notably Mr. H. J. Stiles, favour gastro-jejunostomy, while the late Mr. Clinton Dent preferred pyloroplasty.

The choice between the operations is a somewhat difficult one. It seems obvious that in these young children—often not more than six weeks old and terribly emaciated—one should choose the operation that can be done most rapidly, that will cure the disease, and leave no bad after-results. We chose Loreta's operation because of its rapidity, and we have been very satisfied with the results—recurrence has only taken place in two patients. Gastro-jejunostomy seems a particularly severe operation in these children, although it has been done successfully several times, and there is also the uncertainty attaching to the future of the subjects of this operation. Lastly, pyloroplasty, though theoretically the best operation, is troublesome owing to the great thickening of the pylorus and the consequent difficulty in suturing that structure after it has been divided.

Whatever operation is performed certain *preliminaries* should be observed, as success largely depends on them. The room must be at a temperature of 75° F. or more, the child should lie upon an india-rubber hot-water bottle and have its extremities swathed in cotton-wool. Everything must be ready before the anæsthetic is begun, and the stomach should be washed out just as this is going to be given.

Loreta's operation.—After disinfecting the skin—for which acetone, followed by 2 per cent. iodine solution in rectified spirit is best—an incision 1½ inches long is made through the linea alba from the xiphoid cartilage downwards. The parietes are very thin and the peritoneal cavity may be opened at the first incision. This exposes the liver, which is hooked up with the finger, and the dilated stomach at once comes into view. The stomach is seized and pulled out of the wound, and the enlarged pylorus brought out. The rest of the stomach is then pushed back, the pylorus packed off by an abdominal cloth, and a horizontal incision about three-quarters of an inch long, made into the anterior gastric wall some little distance from the pyloric ring. The edges of the incision are

seized in catch-forceps and held up by an assistant so as to prevent the escape of the gastric contents.

The dilatation of the pylorus is now undertaken. We use Hegar's dilators for this purpose, passing one after the other through the pyloric opening until this admits the little finger easily. This is a very safe method but somewhat tedious, and it requires considerable judgment to perform full dilatation without actually splitting the pylorus. The expansion is carried out until the peritoneal coat shows signs of splitting or the superficial fibres of the pyloric ring give way. The dilator is then withdrawn, after which we are in the habit of introducing a feed of four ounces of weak peptonised milk through a catheter into the duodenum. The incision in the stomach is then closed rapidly in the usual way and the abdomen sewn up.

The chief danger in the operation is rupture of the pylorus or perforation of the duodenum. Rupture of the pylorus generally takes place on its posterior aspect and may escape notice at the time of the operation; it can only be guarded against by the greatest care in performing the dilatation. In all the cases in which this accident has occurred in our hands, the rent has been sutured as in pyloroplasty (see p. 289) and the patient has recovered; in the case in which perforation of the duodenum occurred, the accident passed unnoticed and fatal peritonitis ensued.

The after-treatment demands great care and to it the successful results are largely due. At the completion of the operation a hypodermic injection of half a drop of liquor strychninæ may be given, and it is always well to run in four to six ounces of saline solution beneath the skin in the groins or axillæ. For the first eight hours the child is fed entirely by rectum. After that time mouth-feeding is begun in very small quantities (*vide supra*) and gradually increased. The feeding must be attended to with the greatest care for weeks or even months after the operation. Breast-feeding, either by the mother or by a wet nurse, should be employed as the child recovers. There is a remarkable tendency to the supervention of diarrhœa soon after the operation, apparently as the result of food passing down the intestine again.

NON-OBSTRUCTIVE DILATATION OF THE STOMACH.

Dilatation of the stomach may occur without any organic obstruction to the exit of its contents or adhesions interfering with its mobility. It may be an acute or a chronic condition.

Acute dilatation of the stomach is a very serious condition, and unless recognised and treated early not uncommonly proves fatal. It may occur rapidly and may or may not be accompanied by the same condition in the intestines. The stomach may become enormously distended

both with gas and fluid, and frequent vomiting soon sets in accompanied by prostration, pain, hiccough, and constipation. If the stomach is the only organ which is distended, its outline is quite evident as a large, somewhat pear-shaped swelling at the upper and left side of the abdomen. Even if there is a good deal of abdominal distension, the firmer outline of the stomach can usually be detected and percussion will also help in the diagnosis. There is also frequent vomiting without relief of the condition.

The *pathology* of acute dilatation is by no means clear. It seems to be a paralytic condition of the stomach rather than a contraction of the pylorus or intestine, as has been suggested. The cases which we have seen have usually been associated with some other abdominal trouble, especially acute appendicitis, and it seems to be some toxæmic or reflex effect.

TREATMENT.—The best way is to empty the stomach by means of a tube and then wash it out. We have had a case in which the stomach had so completely lost its contractile power that the only way of emptying it was by putting the patient in the Trendelenburg position. The stomach tube should be used regularly three or four times a day until the contractile power has been regained. Strychnine and antispasmodics may be of value.

Chronic dilatation of the stomach without constriction of the pylorus is most frequently a part of Glénard's disease, and the stomach is usually abnormally low down. The treatment is lavage of the stomach combined with the measures recommended for enteroptosis. Operations such as gastro-jejunostomy and gastro-plication do not seem to benefit the patient.

CHAPTER XIX.

CANCER OF THE STOMACH.

BENIGN growths may occur in the stomach, but they are usually mere pathological curiosities, and the diagnosis is rarely made without an exploratory laparotomy. The simple tumours met with have been generally myomata or fibromata—the former being the more common. They must be removed if possible.

The most common malignant tumour of the stomach is undoubtedly a carcinoma. Sarcoma of the stomach, although occasionally met with, is of extreme rarity.

Carcinoma of the stomach is not an uncommon form of malignant disease, about 2 per cent. of all deaths from cancer occurring from this affection. Men and women appear to be affected in equal proportions; the disease is most common between forty and sixty years of age, and is said to be more prevalent in the tropics than in temperate climates. It is almost invariably a primary lesion, but is sometimes secondary to carcinoma of the œsophagus, pharynx, or breast. The neighbourhood of the pylorus is the most common situation of the affection, about 60 per cent. of all cases starting in that region, and it often seems to arise on a pre-existing ulcer of the stomach.

The growth is usually a cylindrical epithelioma with marked colloid degeneration, and it spreads to a remarkable extent in the coats of the stomach, especially along the lesser curvature. The lymphatic glands are affected comparatively early, the first involved being those along the lesser curvature and those running up towards the liver. Before long, however, the glands in the omentum and about the pancreas enlarge, and the latter is a point of great practical importance, as glands in this situation are extremely difficult to remove satisfactorily. The disease may involve the liver, spleen, or pancreas by direct continuity, and occasionally the case terminates by a general cancerous infection of the peritoneum.

The *symptoms* will vary according to whether or not there is obstruction to the passage of food.

When the growth is situated near the pyloric end of the stomach, there is, in addition to the symptoms proper to the growth, gradually increasing obstruction to the passage of the gastric contents and consequent dilatation of the stomach.

When the growth is situated at the cardiac end, the entrance of food into the stomach is hindered, and the symptoms may be practically those of œsophageal obstruction.

When the growth is situated in the body of the organ the symptoms proper to cancer of the stomach are chiefly in evidence. These are severe pain and dyspeptic symptoms combined with the most profound malnutrition. The patient is sallow and anæmic, loses flesh rapidly, and suffers to a marked degree from the cancerous cachexia. Vomiting is frequent, and the contents of the stomach show altered blood and absence of free hydrochloric acid. The latter point is one of the most marked symptoms of cancer of the stomach and is a valuable diagnostic point in deciding between it and gastric ulcer. The entire gastric mucous membrane is in a condition of chronic catarrh and rapidly atrophies. Free hydrochloric acid soon disappears and its place is taken by lactic acid resulting from the fermentation of the stomach contents; these have a peculiarly offensive odour. The presence of the Oppler-Boas bacillus is extremely suspicious.

Sometimes the tumour can be felt through the abdominal wall, but this is not always the case, either because the growth is small or because the organ is drawn up under the liver. Occasionally the weight of the tumour drags the stomach down into the abdomen and it is then quite easily felt. When the growth is situated at the pyloric end it is generally small, but when on the anterior surface of the stomach it may attain a considerable size; when at the cardiac end the growth cannot as a rule be felt unless it is very extensive. If a large bismuth meal is given and an X-ray photograph taken immediately afterwards, it may be possible to see the encroachment of the growth upon the lumen of the viscus; this is not pathognomonic, however, as a similar appearance may be presented by perigastric adhesions or by spasm of the wall of the stomach.

TREATMENT.—The treatment of cancer of the stomach may be either medical or surgical. As far as the former is concerned, it is limited to the treatment of the symptoms, and when no operation is advisable, the patient must be made as comfortable as possible, especially as regards pain. Surgical measures consist either in complete extirpation of the growth and any infected glands, or in some palliative procedure, chiefly with the view of relieving the obstruction to the passage of food.

The surgical treatment suitable for cancer of the stomach will vary with the situation of the disease; we may therefore consider first the treatment of cancer of the body of the stomach not causing obstruction at either orifice—the so-called non-obstructive cancer of the stomach;

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then that of cancer of the pyloric end ; and finally that of cancer at the cardiac end.

1. Of non-obstructive cancer of the stomach.—Here the growth is usually situated on the anterior surface or on the lesser curvature, and when it is small and unaccompanied by glandular enlargement or adhesion to surrounding structures it may be possible to extirpate it with a fair prospect of cure. It must, however, be admitted that the number of cases that come under observation in which this is feasible is very small, because when the growth is small enough to be easily removed, it commonly happens that no tumour can be felt from the outside and the diagnosis is not made.

Gastrectomy.—Extirpation of portions of the stomach for cancer—*partial gastrectomy*—is not a hopeful procedure. This depends not so much upon the fact that the operation in itself is severe, because the most extensive operations, even those involving a resection of the entire stomach, have been performed without the patient succumbing, but on the fact that the growth spreads rapidly through the stomach wall, and recurrence after these partial operations is almost invariable.

If radical measures are to be undertaken in these cases with any hope of avoiding recurrence, they should take the form of excision of the whole or the larger portion of the stomach—*complete gastrectomy*. Although the entire stomach has been removed for cancer with temporary success, the number of cases in which this can be done is not large, and we do not look upon the operation as at all a favourable one. The chief objections are that when cancer involves a large part of the stomach the disease is very likely to be extensively diffused both through the neighbouring glands and through structures that have become adherent to the stomach. When glands are found to be extensively affected, extirpation of the primary growth should not be attempted. In connection with enlarged glands it is important to remember that they may be met with not only in cancer, but also in simple ulcer of the stomach, and they may give rise to considerable difficulty in diagnosis. The question may be settled by dissecting out one of the glands and making a rapid microscopical section. Even to the naked eye the typical hard whitish cancerous gland differs markedly from the soft swollen juicy glands associated with inflammation.

In the rare cases in which the operation may be done, the stomach is divided at the cardiac and pyloric ends and the viscus is removed entire, the duodenum being subsequently sutured to the cardiac end of the œsophagus.

Should it be found on performing an exploratory laparotomy that the growth is so large and so extensively diffused over the surface of the stomach as to negative a radical operation, the best plan is to close the abdomen without doing anything further. It has been suggested that when the disease in the stomach is so extensive as to prevent the patient taking food, the operation of duodenostomy, or preferably jejunostomy,

should be performed. This can be done if the patient wishes it, and it may prolong his life for a few weeks, but it is questionable whether it is really worth while.

2. Of cancer obstructing the pylorus. — In these cases the exit from the stomach is interfered with comparatively early, and therefore the surgeon is frequently called in while the disease is still limited and while operation is more hopeful. The chief procedures at his disposal are the following: (*a*) If the growth is limited and mobile, pyloro-gastrectomy, *i.e.* excision of the pylorus and a considerable portion of the adjacent stomach—particularly the lesser curvature—may be performed, followed by gastro-jejunostomy; (*b*) if the growth cannot be removed, gastro-jejunostomy may be performed; (*c*) failing either of these procedures, a duodenostomy or jejunostomy will prevent the patient dying of starvation.

If possible pyloro-gastrectomy should be chosen because that operation not only relieves the obstruction, but also may rid the patient of the disease, for a considerable time at any rate. The points in favour of pyloro-gastrectomy are a small tumour, mobility of the pylorus, and absence of enlarged glands, or at any rate, only slight infection of them; the condition of the patient should of course be such as to enable him to stand an operation that must necessarily be of considerable severity. Against pyloro-gastrectomy, on the other hand, are extensive disease, involvement of the glands, adhesion of the pylorus to the surrounding structures showing that the disease has passed the limits of the wall of the stomach, or such a feeble condition of the patient as not to warrant a prolonged operation.

Formerly, the operation performed in these cases was pylorectomy, but a study of the method of spread of the disease along the lesser curvature and of the distribution of the lymphatic vessels and glands has shown that the only safe procedure is to carry the line of section through the stomach from the left end of the lesser curvature to the centre of the greater curvature, thus removing all the lesser curvature and half the greater as well as the pylorus. In addition, all the glands above and behind the pylorus must be removed, together with those along the coronary and right gastro-epiploic arteries and along the upper border of the pancreas. The operation of pyloro-gastrectomy is performed as follows:—

Pyloro-gastrectomy combined with gastro-jejunostomy.—Before proceeding to operate, a few days may sometimes be devoted with advantage to preliminary treatment, as these patients are almost invariably suffering from extreme malnutrition when they first come under notice. This will depend entirely upon the degree of stenosis of the pylorus; if this is very marked nothing is gained by delaying the operation, as absorption from the stomach, even of highly digestible substances, is very feeble, owing to the catarrhal and atrophic condition of the mucous membrane,

while rectal feeding is of very little value under these circumstances. If, however, the stenosis is slight, it may be advantageous to devote a week or so to feeding the patient with concentrated nutritious food, such as soups, peptonised milk, and meat juice, whilst the stomach is washed out twice daily with boiled water to get rid of any fermenting contents; at the end of each irrigation 10–15 grains of salol may be introduced and left in the stomach.

The anæsthetic employed for the operation should be ether (open or intravenous), or the A.C.E. mixture. Before commencing the anasthetic the stomach should be emptied and washed out. All the precautions against severe shock, referred to in connection with severe abdominal operations on p. 199 must be adopted.

The incision should be rather to the right of the middle line and extend from the xiphoid cartilage to below the umbilicus. On opening the peritoneal cavity, the condition of the pylorus should be first examined, especially its mobility, the presence or absence of adhesion to

FIG. 109.—CLAMP FORCEPS FOR USE IN PYLORO-GASTRECTOMY. These are very useful for dividing the omenta. They crush firmly and have toothed ends that prevent the structures slipping out of the ends of the forceps.

surrounding structures, and the presence and distribution of enlarged glands. The posterior surface of the pylorus can be explored by tearing a hole in the lesser omentum immediately above it and introducing the finger behind it. This also allows the posterior surface of the stomach and the pancreas to be examined, and the presence or absence of enlarged glands in front of the vertebræ or above the pancreas can be made out.

When this has been done and the operation has been decided upon, the first step is to free the pylorus. The edges of the abdominal wound are widely retracted, the general peritoneal cavity is carefully packed off with abdominal cloths, and the pylorus freed by dividing the gastro-colic omentum between two pairs of long clamp-forceps (see Fig. 109). The vessels in the omentum can be tied separately or *en masse;* after the pylorus has been removed. The lesser omentum, as a rule, can be divided by tearing it with the finger if care be taken to keep close to the pylorus; any bleeding vessels can be picked up as they are divided. A point of great practical importance is to detach the lesser omentum right up to the cardiac end and well above the lesser curvature so as to ensure that the glands contained in it are removed. The pyloric and gastro-duodenal

branches of the hepatic artery are exposed in doing this and should be divided between two ligatures.

After the omenta have been divided, the growth is separated by the finger from the structures, posteriorly, so as to allow the whole mass to be drawn well up into the wound. As the adhesions are divided, the tumour comes right up into the wound until finally the operation can be completed entirely outside the abdomen. Care is taken that all the glands along the greater and lesser curvatures are separated and left in connection with the pyloric end of the stomach. Any enlarged glands behind the stomach are left until after the tumour has been taken away. The gastro-epiploica sinistra artery should be divided at this stage between two ligatures opposite the point at which the line of section of the stomach will reach the greater curvature.

The next step is to clamp the duodenum on each side of the proposed line of section through it. The forceps on the proximal side of the incision through that organ should be powerful clamp-forceps that will crush the walls of the gut together and avoid all risk of the escape of the contents of the portion of the stomach removed. Those on the distal side are merely to occlude the lumen temporarily and need not be so powerful ; they may have their blades covered with rubber. The surgeon now cuts through the duodenum and an assistant raises the pyloric end of the stomach and pulls it out of the abdomen over to the left, together with the tumour. It is then covered up in abdominal cloths and kept out on the abdomen away from all risk of fouling the peritoneal cavity, whilst the surgeon proceeds to suture the distal end of the divided duodenum in two layers in the usual manner. This must be done very carefully, as experience shows that if leakage occurs, it is almost always from the end of the duodenum. In order to make absolutely sure both of occlusion of the bowel and the avoidance of sepsis, some surgeons use powerful crushing-clamps, such as those shown in Fig. 110, and divide the bowel on the proximal side by the actual cautery, the adjacent parts being carefully protected from the heat by thick pads and good retraction. A ligature is then tied round the end of the duodenum on the distal side of the crushing-clamp and the latter removed. This closes the duodenum without any risk of contamination from the divided end of the bowel. The closed distal end is then invaginated by a double layer of continuous Lembert sutures, so that there shall be no possibility of leakage.

The proximal end of the duodenum is now lifted well up, with the crushing-clamp attached, and the separation of the stomach proceeded with. The great omentum is ligatured with a series of interlocking ligatures (see p. 318) right up to the proposed line of section in the stomach—namely, about half-way along the greater curvature. In doing this, the greatest care must be taken not to damage the middle colic artery which lies in the transverse meso-colon. The omentum is then divided between the stomach and the ligatures, the glands being left in

connection with the pylorus. If the stomach is now turned well over to the left the cœliac axis will be exposed, and the coronary artery is ligatured and divided.

Before proceeding to divide the stomach, it is a good plan to perform

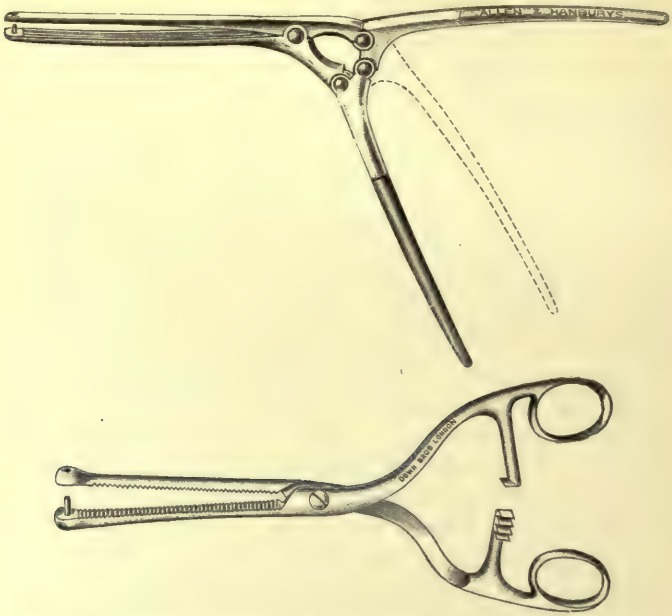


FIG. 110.—CRUSHING CLAMPS FOR INTESTINAL RESECTION. The upper figure shows a very powerful type by which the thickest parts of the intestine are easily reduced to the thickness of tissue paper. The dotted line shows the position of the upper handle when the forceps are closed. The lower figure is a useful form for all small intestine resections.

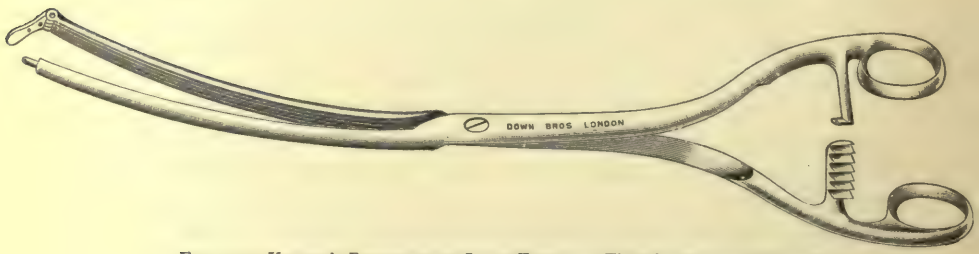


FIG. 111.—KOCHER'S PYLORECTOMY CLAMP FORCEPS. There is a catch at the ends of the blades to maintain the pressure and to prevent any portion of the stomach wall escaping from their grasp.

the gastro-jejunostomy, as it is done much more easily than after the bulk of the organ has been removed. The operation is quite similar to that described on p. 265 ; the only important point to remember is that there must be plenty of room between the anastomosis and the proposed line of section of the stomach—in other words, the anastomosis

must be well over towards the cardiac end. A long powerful clamp, such as Kocher's (see Fig. 111) is now laid along the proposed line of section of the stomach—namely, from the left end of the lesser curvature to the middle of the greater curvature (see Fig. 112, A)—and closed firmly. A second clamp is then applied, a little to the distal side of this, and the stomach divided between them, either with the scissors or cautery, as the surgeon prefers.

The next step is to close the divided end of the stomach by a continuous stout catgut suture, taking up all the coats; this closes the stomach cavity and at the same time compresses oozing points. The

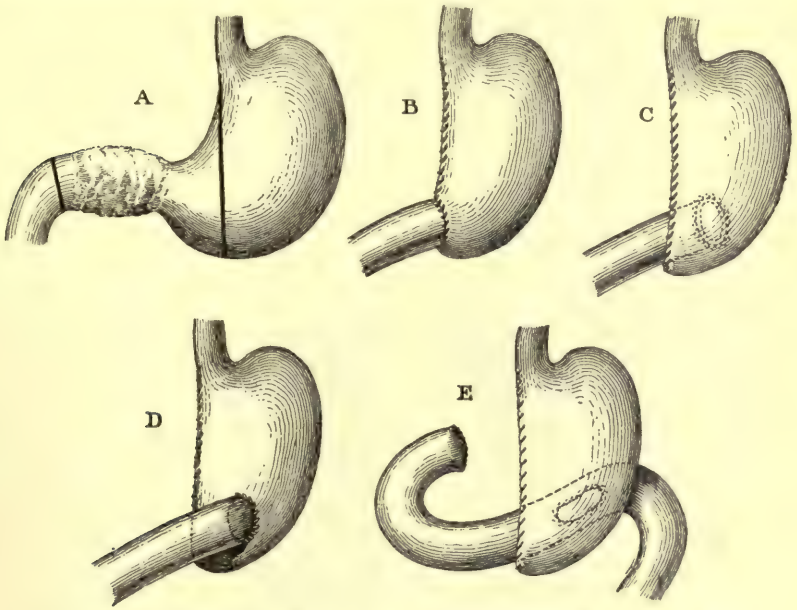


FIG. 112.—VARIOUS METHODS OF PERFORMING PYLORO-GASTRECTOMY. In the first figure, A, is shown the lines of incision for removing the growth, while the others indicate different methods by which the continuity of the intestinal canal is restored subsequently. The method shown in E—namely, invagination of the duodenum followed by posterior gastro-jejunostomy—is the one most to be recommended.

occluding suture is then buried by a fine continuous sero-muscular suture.

All that now remains to be done is to remove all glands that lie above the pancreas, clean up the operation area carefully, and close the abdomen.

After-treatment.—This is precisely the same as for gastro-jejunostomy (see p. 275). The shock is nearly always profound, but is not so grave as might be anticipated from the severity of the operation. It is generally advisable to introduce a quantity of saline solution into both axillæ and also to start saline injection into the rectum by the drop method.

The plan just described is the one that is chiefly in favour at present. There are many other ways of doing the operation, which vary chiefly in the way in which the continuity of the alimentary tract is restored. Fig. 112 shows the chief of these. For the purpose of removing all the glands and most of the stomach, however, the surgeon will find the one we have described the best in most cases and often the only one suitable.

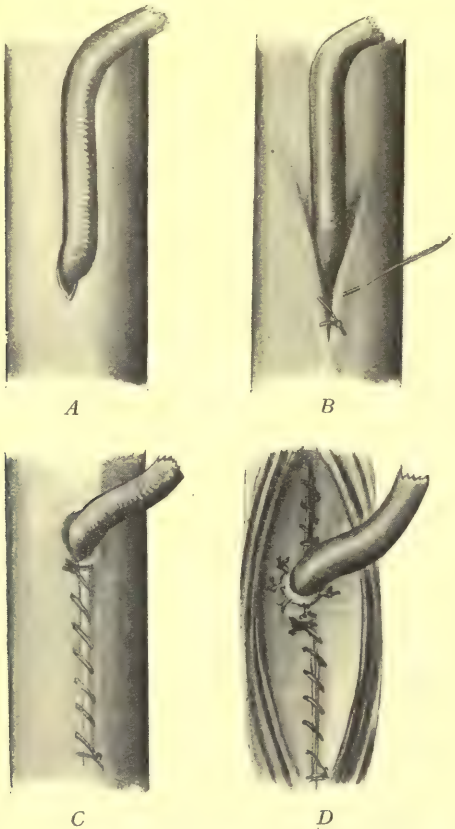


FIG. 113.—DUODENOSTOMY OR JEJUNOSTOMY BY WITZEL'S METHOD. *A* shows the catheter in the bowel; *B* the intestinal wall being brought over to cover in the catheter; *C* the tube completely enclosed; and *D* the bowel secured to the abdominal wall.

Gastro-jejunostomy.—If the surgeon finds that it is inadvisable to perform pyloro-gastrectomy, the best thing to do is to establish a communication between the stomach and the jejunum in the ordinary manner (see p. 265). The anterior operation may be required in a case of this kind, as there may be such extensive adhesions that the posterior surface of the stomach cannot be properly exposed.

Duodenostomy or Jejunostomy.—The only other procedure at all likely to be of use in these advanced cases of cancer is to establish a perma-

nent opening in the duodenum or the jejunum. This may be called for when the cancer is too far advanced for excision and also when it spreads so extensively over the surface of the stomach that there is no possibility of performing a gastro-jejunostomy successfully. A permanent opening on the further side of the growth is therefore the only means of prolonging the patient's life, but in these cases he is so near death when the operation is performed that the chances of any material prolongation of life are extremely slight.

The operation is done through the ordinary vertical incision, slightly to the right of the middle line, and the duodenum, if possible—or, failing that, the jejunum—is brought up into the wound, fixed in position by sutures and an opening made and a tube fastened in, as in gastrostomy (see p. 183). Witzel's or Kader's methods are the best in these cases, as the opening in the bowel must be very small so as not to interfere with the passage of bile and pancreatic secretion past the artificial orifice ; it is particularly important not to form a spur, as is done in inguinal colostomy, otherwise the bile and pancreatic secretion will be discharged through the wound, to the patient's great discomfort and disadvantage.

3. Of cancer of the cardiac end of the stomach.—This condition is practically identical with malignant disease of the cardiac end of the œsophagus—at any rate, as far as its treatment is concerned (see p. 180). Gastrostomy or jejunostomy are the only surgical procedures.

CHAPTER XX.

DUODENAL ULCER: JEJUNAL ULCER.

DUODENAL ULCER.

Ulcer of the duodenum first attracted attention in connection with burns, and in these cases is supposed to be due to some toxic condition in connection with the septic state of the wound. The ulcer is generally in the first part of the duodenum, and most often above the entrance of the bile-duct. Hæmorrhage not infrequently results, and sometimes perforation. Uræmic and tuberculous ulcers have also been described.

The condition to which we refer in this chapter is, however, the chronic duodenal ulcer, which is not at all uncommon and which in its characters and probably in its origin is closely allied to the chronic gastric ulcer. The great majority of these ulcers are situated in the first part of the duodenum, and occur most often in men about middle life.

The *symptoms*, which have been especially worked out by Moynihan, are as follows: There is often a history of weight and distension in the epigastrium after meals, to which very little attention is paid, but later the patient begins to notice that pain, which is often very severe, comes on two hours or more after food, or earlier if the diet is fluid. It is relieved by taking food; Moynihan has therefore given the name of 'hunger pain' to this symptom. Vomiting is rare. The symptoms are not constantly present, but come on in attacks, most often in winter. Heartburn or pyrosis is not uncommon. Little or nothing may be made out on examination, but in some cases there may be tenderness in the middle line, combined with some rigidity and increased reflex of the upper part of the right rectus.

Hæmorrhage is a common complication of duodenal ulcer and its presence is a very strong point in favour of the diagnosis. It may be present in large amount, giving the characteristic melæna, but in many

cases it is not noticeable with the naked eye, though present on examination as 'occult blood' (see p. 235). When marked hæmorrhage occurs in duodenal ulcer, it is serious, and may be fatal. On X-ray examination after a bismuth meal, it has been found that the stomach empties itself more quickly when there is no constriction than in the normal condition.

Although by some the diagnosis of duodenal ulcer is considered to be quite easy, there is no doubt that the average surgeon fails to find a duodenal ulcer in many cases in which it was expected. It has happened so often in these cases that the only lesion found has been a diseased appendix, that there is now a well recognised form of appendicitis known under the name of 'appendix dyspepsia.' According to Moynihan this condition can be diagnosed from duodenal or gastric ulcer by the fact that in the appendix cases the pain is not acute, is generally confined to the epigastrium, and is set up by pressure in the right iliac fossa ; that vomiting is frequent, and that there are not the intervals of freedom from pain which occur in cases of ulcer. Duodenal ulcer may also be mistaken for gastric ulcer or gall-stones or entero-spasm, and *vice versâ*.

TREATMENT.—As a rule, medical treatment has been carried out for some time before the case is handed over to the surgeon, and consists in regulation of the diet, rest, change of scene, the administration of normal horse-serum, olive oil, bismuth and soda, and similar drugs.

The surgical treatment consists in dealing with the ulcer either by excision or infolding, or by performing gastro-jejunostomy, or by both. The incision should be a vertical one through the middle of the right rectus and sufficently long to give a good view of the parts. This incision also enables the surgeon to examine the stomach and gall-bladder and appendix. The duodenum must be examined carefully in the first instance, and if there is no evidence of ulcer on its anterior surface, the peritoneum must be divided about two fingers' breadth outside the duodenum and the latter raised so as to investigate the posterior surface. If no evidence of ulcer is found, gastro-jejunostomy should not be performed as it will not only do no good, but may set up troubles, especially in the way of vomiting, which did not exist before. Under such circumstances other sources for the symptoms should be looked for. If an ulcer is found, it may be treated by excision either of the ulcer alone or of the piece of diseased duodenum, or by gastro-jejunostomy combined with infolding of the ulcer or artificial constriction of the pylorus. The latter is the method which is most generally applicable ; excision of the ulcer is very seldom possible, but infolding of it seems to have a very beneficial effect. One need not hesitate about infolding it freely if it is situated above the orifice of the bile-duct or, at any rate, if its infolding does not obstruct that orifice ; and under such circumstances the pylorus may not be constricted.

If the ulcer is situated on the anterior surface of the duodenum and is quite small, it may be enclosed in two horizontal semi-elliptical incisions which are afterwards stitched together vertically. Excision may also be necessary in cases of hæmorrhage ; or if this is not possible, the artery from which the blood is coming must be tied. Resection of the affected portion of the duodenum with or without the pylorus has also been done, followed by end-to-end union or by side-to-side anastomosis.

If gastro-jejunostomy is decided on, the ulcer should be also infolded by a double layer of sero-muscular sutures, and if necessary a similar running suture is passed around the greater part of the pylorus so as to constrict it. In most cases a posterior gastro-jejunostomy (see p. 265) is then performed, but if the duodenum is very fixed it is safer to choose the anterior operation (see p. 271), otherwise the ulcer may perforate during the manipulations.

Moynihan recommends that in all these cases the appendix should be also examined, and if necessary removed, as he holds that gastric and duodenal ulcers are due to toxæmia, which frequently originates in connection with the appendix. Adhesions kinking the bowel should also be divided, and the raw surface smeared with sterilised vaseline with the view of trying to prevent their recurrence.

PERFORATED DUODENAL ULCER.

Perforation is not at all infrequent in duodenal ulcer, and may or may not be preceded by symptoms of previous disease. It is not uncommon to find that the patient's attention has not been directed to the abdomen beforehand, although on questioning him, he may remember transient dyspeptic troubles. The pain is usually extremely severe and sometimes there is much shock. At first rigidity may not be very marked, less so than in ruptured gastric ulcer, but it soon becomes extreme. The respiration is rapid and jerky. After a time the patient complains of pain in the right iliac fossa, and many of these cases are operated on under the impression that they are cases of acute appendicitis ; in duodenal ulcer, however, the most painful spot is in the right hypochondrium, and the jerky rapid breathing is very characteristic. If there is escape of gas when the abdomen is opened it is at once evident that the alimentary canal has been perforated. Perforation of a duodenal ulcer must be diagnosed from perforated appendix, perforation or gangrene of the gall-bladder, acute pancreatitis, and pneumonia or pleurisy.

The *operation* is similar to that for perforated gastric ulcer, and the duodenum is reached by an incision through the upper part of the right rectus. The opening in the duodenum should be stitched up by a double layer of sutures, and then the parts should be thoroughly cleansed. An incision should be made in the right iliac region and the fluid which

has accumulated there evacuated. Tubes are put in in both places, and also one in the left iliac region. Gastro-jejunostomy need not be performed at the time unless the closure of the ulcer unduly constricts the lumen of the duodenum. The details of the treatment are the same as for perforated gastric ulcer (see p. 285).

When the ulcer has become adherent to other structures before the intestinal wall has been eaten through, an abscess may form, which burrows especially backwards, and may result in a duodenal fistula after bursting or being opened. If this persists, something must be done, and gastro-jejunostomy with closure of the pylorus is the line of treatment which seems most suitable.

JEJUNAL ULCER.

An ulcer may form in the jejunum, either at the line of junction of the stomach and jejunum in the case of gastro-jejunostomy, or lower down in the jejunum itself; the great majority occur at the line of the anastomosis, perhaps most frequently after the anterior form of the operation. The ulcers are often acute, and may appear within a few days after the operation, and they are very apt to perforate. Some are more chronic and present symptoms similar to those of the original trouble. Their cause is indefinite; they may be due to the same cause as produced the original ulcer, and they have been attributed to the presence of an unabsorbed suture at the line of junction, or to a hæmatoma.

The treatment is very difficult. The ulcer, if perforated, may be closed, or, whether perforated or not, it may be advisable to resect the portion of bowel involved. This may mean excision of the line of union with the stomach; if this is done, a fresh union may be made at a lower level, and the upper limb implanted into the lower, forming a sort of Y-operation. For information about this rare condition, the work on Duodenal Ulcer, by Sir B. G. A. Moynihan, may be consulted.

CHAPTER XXI.

INJURIES OF THE INTESTINES, THE OMENTUM, AND THE MESENTERY.

THESE injuries closely resemble those of the stomach, and only the special points relating to them need be considered in detail. The effects of the injury differ according as it is caused by a sharp or a blunt instrument, and the two important results which may be produced are bleeding and injury to the intestinal wall.

Severe and often fatal *hæmorrhage* may occur from the omentum or the mesentery as the result of an external injury, while the intestine itself may escape. The lesion in the omentum or mesentery may vary from a simple longitudinal tear rupturing only one or two vessels, to an extensive laceration, or even detachment of the mesentery from the spine or from the bowel; in the latter case very serious secondary intestinal troubles may result from the injury to the blood-supply of the bowel if the patient survives long enough. On opening the abdomen after an injury and finding blood, the surgeon must bear in mind that there are various other and more probable sources of the hæmorrhage than injury of the omentum or mesentery, and he must more especially examine the liver and spleen.

As the result of an external injury, partial or complete *rupture of some portion of the intestinal canal* may occur. The parts most frequently affected are the jejunum and the ileum; but in severe crushes, as when a heavy cart passes over the abdomen, the more fixed portions of the intestine, such as the duodenum and the ascending or descending colon, suffer most. The injury may vary from a simple contusion to an extensive laceration or complete division of the intestine; the injuries may be limited to one coil of bowel or they may be multiple. As a rule they are more often multiple in penetrating wounds than in contusions; the possibility of multiple injuries must be borne in mind when the abdomen is opened for the purpose of investigating cases of this kind.

When the injury to the intestine is limited, it is most frequently met with on the convex surface ; in bad contusions the bowel may be torn asunder, usually a movable from a more fixed portion, such as the jejunum from the duodenum or the ileum from the cæcum. The transverse colon is the part of the large intestine most frequently injured ; after that, the cæcum and then the descending colon.

After rupture of any part of the small intestine except the duodenum, the contents of the bowel pass directly into the general peritoneal cavity. The second and third parts of the duodenum, however, are not entirely surrounded by peritoneum, and if the rupture occurs on the posterior surface, extravasation of the contents will take place into the sub-peritoneal cellular tissue ; this leads to the formation of an abscess which points in the lumbar, iliac, or sub-diaphragmatic region. These wounds of the duodenum with infection of the cellular tissue behind it are very fatal ; as a rule the patient dies of septic poisoning and, unless the nature of the injury is recognised and dealt with at once, it is rarely possible to do anything effectual in the way of treatment. The same is true of wounds affecting the posterior surface of the ascending or descending colon.

THE DIAGNOSIS BETWEEN HÆMORRHAGE AND RUPTURE OF THE BOWEL.

If the case is one of hæmorrhage, there will be the general symptoms of shock—such as collapse, pallor, feeble and quick pulse, and sighing respiration—while at the same time there may be localised areas of dullness in the abdomen. The flanks should be carefully percussed, and examination *per rectum* and *per vaginam* should always be made ; the presence of a fullness in the pelvis, due to blood accumulating there, may be detected. Nevertheless, there may be a large amount of blood in the peritoneal cavity without any dullness being elicited on percussion, and in the pelvis without any fullness being detected. After a time, when the blood has clotted, a boggy feeling may be found on vaginal or rectal examination, or a distinct bulging of the rectal wall or pushing down of Douglas's pouch. Continued marked collapse, with extreme pallor and the general signs of hæmorrhage—especially a rising pulse-rate—indicate hæmorrhage, and these symptoms call for immediate operation.

In rupture of the intestines, the initial shock is not always great and may pass off comparatively quickly ; in fact, it is not unknown for a patient to continue at work for some time after the bowel has been ruptured. There is usually severe localised pain and rigidity at the site of the injury. Vomiting is often present and persistent, and it may increase in frequency and violence, but blood is not present in the vomit, nor are the stools black. The pulse at first may be normal, but it steadily increases in rapidity and diminishes in volume. When the

rupture is a large one, there may be areas of dullness due to extravasated intestinal contents, but usually gas also escapes and gives rise to a tympanitic note, and the liver dullness may be absent. If some time has elapsed since the injury, signs similar to those indicating free gas in the peritoneal cavity may be caused by the general intestinal distension due to peritonitis.

TREATMENT.—When a person has received an abdominal injury, the first point to decide is whether there is an intra-abdominal lesion or not; given a patient with the symptoms of such a lesion, laparotomy should be performed without delay, unless the patient is already moribund. It is better to open the abdomen and find no lesion than to wait in order to make the diagnosis certain, for in the great majority of cases in which a lesion is present, delay would mean an almost certain fatal result from hæmorrhage or septic peritonitis. It must be borne in mind, however, that the patient is often in a condition of collapse immediately after a severe injury to the abdominal parietes even when there is no intra-abdominal lesion. If the surgeon decides to wait a little before opening the abdomen, absolute rest in the dorsal position should be maintained and the pulse-rate should be recorded every half-hour. A rising pulse-rate may be taken to indicate a lesion and calls for operation. On the other hand, a falling and improving pulse may be taken as a contra-indication to immediate operation; but even then, the patient should be carefully watched for days to see whether any complication arises.

The operative treatment may be considered under three heads—namely, (1) treatment of internal hæmorrhage; (2) treatment of a recent injury to the bowel; and (3) treatment of cases in which a considerable time has elapsed after the injury before the case comes under the notice of the surgeon.

TREATMENT OF INTERNAL HÆMORRHAGE.

A vertical incision, at least six inches long and with its centre opposite the umbilicus, should be made through one or other rectus—according to any indications there may be as to the side upon which the injury is situated; this can be enlarged upwards or downwards if necessary. Attempts have been made to perform these operations under local infiltration anæsthesia; these, however, do not seem to be satisfactory. If, however, the shock is great, it is of advantage to employ spinal anæsthesia or the intravenous administration of ether or hedonal (see p. 32). The chief objection to spinal anæsthesia is the necessity for moving the patient.

The steps of the procedure to be followed immediately after opening the abdominal cavity for any serious injury to its contents are described on p. 199. The object is to ascertain with the minimum amount of disturbance to the parts whether there is a perforation of the bowel or

serious internal hæmorrhage, and whether the latter proceeds from one of the large viscera, such as the liver or spleen, or whether it is superficial or deep to the omentum.

When the bleeding comes from an injury to the omentum, that structure should be laid out upon a hot abdominal cloth and inspected. The omentum may be torn either vertically or transversely; in the latter case the hæmorrhage is much more severe than in the former. Sometimes the blood, instead of escaping into the peritoneal cavity, infiltrates the substance of the omentum and gives rise to a large localised hæmatoma.

When the omentum is wounded near the stomach or transverse colon, the abdominal incision should be extended upwards so that the entire structure can be examined without having to employ any traction; it is an extremely delicate membrane, and traction may increase the rent, or rupture some large vessel and thus add seriously to the bleeding. When time is of great importance, the incision may be extended upwards by slitting up the whole thickness of the abdominal wall with strong scissors or a probe-pointed bistoury, clamping any bleeding points afterwards.

In dealing with this injury, two objects must be aimed at—namely, to arrest the hæmorrhage, and to avoid leaving either a hole in the omentum through which bowel might pass and become strangulated, or a loose strand which might subsequently form a band and so lead to intestinal obstruction in the future.

A simple vertical rent in the omentum should be sewn up accurately with a curved needle and fine catgut after any bleeding vessels have been tied. It requires some care in doing this to avoid puncturing other vessels which might give rise to troublesome bleeding and cause much loss of time. Should this accident take place, it is best to underrun the wounded vessel with catgut.

When there is a transverse rent of the omentum, the procedure will depend upon its extent. Small rents can be stitched up after the vessels have been tied; in the case of more extensive tears it will be best to remove a triangular portion of the omentum (see Fig. 114) and then to stitch the sides of the opening together.

When there is a large hæmatoma in the omentum, it is often very difficult to find the bleeding point, and as the large mass will ultimately lead to adhesions, it is better to remove the part of the omentum involved or the whole of it if necessary. This is done by inserting a series of interlocking ligatures around the hæmatoma (see Fig. 115); the piece of the omentum thus isolated is then excised and the cut surfaces stitched together with fine catgut.

When the bleeding comes from an injury to the mesentery or the meso-colon.—Should it be found on opening the abdomen that the omentum is uninjured, but that there is free hæmorrhage coming from beneath it, the omentum and transverse colon should be turned out on to

a hot abdominal cloth spread upon the upper part of the abdomen and then covered with another, and the hand slipped down along the under-surface of the transverse meso-colon as far as the spine, where the

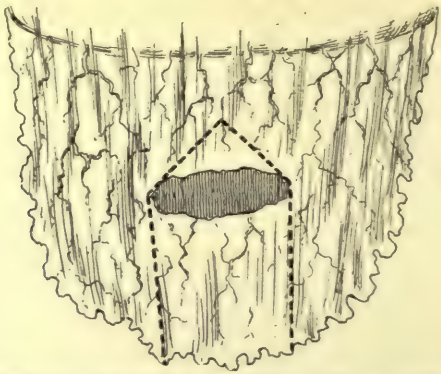


FIG. 114.—METHOD OF TREATING A HORIZONTAL RENT IN THE OMENTUM. The shaded area represents the gap made by the laceration; the dotted lines are the lines of section of the omentum (after ligature of the vessels) in order to make a gap that can be easily sutured.

aorta will be felt and may be compressed, together with the root of the mesentery, so as to arrest the hæmorrhage temporarily, whilst the bleeding

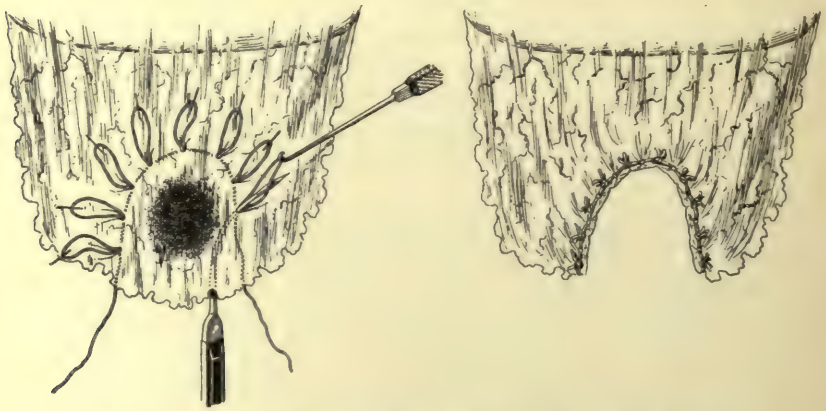


FIG. 115.—REMOVAL OF A HÆMATOMA FROM THE OMENTUM. A very long thread is taken and the omentum transfixed all around the hæmatoma as depicted above. A series of loops is made and these are divided along the marks shown in the diagram so as to produce a number of separate ligatures which are tied one by one. As the needle is made to transfix the omentum each time the thread is caught by a hook or by forceps, the needle withdrawn still threaded and made to transfix the omentum again further on, where the same procedure is repeated. The gap shown in the right-hand sketch is closed by a few points of suture between the opposite sides. Before tying, each thread is twisted round the adjacent one of the suture following, so as to interlock.

spot is being searched for. This temporary arrest of the bleeding should then be entrusted to an assistant, so as to leave the surgeon's hands free. The search for the bleeding point is best carried out by rapidly turning out

the intestines, swabbing away blood or clot from the coils as quickly as possible and then returning coil after coil into the abdomen until the seat of hæmorrhage is found. The best plan is to begin at the junction of the ileum with the cæcum and examine and put back the coils of small intestine from that point; subsequently, the meso-colon can be examined in the same manner. When the bleeding point has been found, it may be compressed whilst the wound is enlarged or the intestines arranged so as to make it as accessible as possible.

The further procedure will depend upon the nature of the injury; when this is *a mere slit*, the bleeding point can usually be seized in forceps, a ligature applied, and the slit stitched up with fine catgut, taking care not to puncture other vessels with the needle.

A transverse tear of the mesentery is a much more serious matter and generally takes place close to the intestine; should it occur at the root of the mesentery the patient will probably have bled to death before surgical assistance can be obtained. The importance of these cases is due not only to the free bleeding to which they give rise, but also to the serious damage to the blood-supply of the corresponding segment of the intestine; when the tear is at all extensive, the portion of intestine from which the mesentery has been detached may be completely deprived of its blood-supply and will subsequently become gangrenous. It is uncertain how much of the mesentery may be thus detached without causing gangrene, but it is not very much; if it is detached for two inches or more, gangrene is practically certain to occur, and under such circumstances it becomes absolutely necessary to remove the corresponding portion of the bowel and unite the two ends either by end-to-end suture or by lateral anastomosis. When the rent is less than an inch long, it may be sufficient to tie the bleeding points and re-attach the mesentery to the intestine by sutures. This question of interference with the intestinal blood-supply must be considered even in vertical rents, because the bleeding vessel may supply a considerable section of the intestine, and its ligature may lead to gangrene in the area of distribution of its branches just as if that portion of the mesentery had been torn away from the bowel; a certain amount of the intestine may therefore have to be excised in these cases also.

When the injury is situated at the root of the mesentery, it is extremely difficult to tie the bleeding points, and attempts to do this sometimes lead to further laceration of the vessels, because the forceps are very apt to tear through or the mesentery may become damaged still further by the manipulations. When there is much trouble of this kind, the simplest plan is to leave on the forceps which secure the bleeding point. Their handles are left protruding through the abdominal wound, which is stitched up completely except at the point where the forceps emerge; here temporary stitches are inserted, and these are tied when the forceps are removed. At the end of forty-eight hours the forceps may be

gently unlocked and withdrawn from the wound, the temporary stitches tied and the wound closed. In these cases the question of subsequent gangrene of the bowel is especially important.

When the bleeding has been arrested, it is well to flush out the abdomen with hot sterilised saline solution (see p. 245). This is done partly to remove clots which, if left behind, may organise and give rise to troublesome adhesions, and partly to fill the blood-vessels with fluid. If necessary, a saline intravenous or subcutaneous injection may also be employed. As a rule the abdominal wound can be closed without any drainage; when, however, slight oozing is still going on, it is well to introduce a drainage tube into Douglas's pouch, but it need not be left in for more than twenty-four hours.

TREATMENT OF RECENT INJURIES TO THE INTESTINAL WALL.

The prognosis of intestinal rupture is very grave, the average duration of life from the time of the accident being about forty-eight hours, and therefore the operation must be done as soon as possible after the receipt of the injury; at a later period the chances of eradicating sepsis are very slight and attempts to do so by extensive manipulation of the inflamed intestines and peritoneum give rise to the most profound shock, of which the patient will probably die. Hence, unless the operation can be performed during the first few hours (certainly within the first twenty-four), it is better, in most cases, to leave the patient alone in the slight hope that the inflammation will become localised and followed by the formation of an abscess. When therefore the surgeon is called to a case of this kind, he should go prepared to operate so as not to lose any time.

Appropriate measures should be taken to reduce the shock to a minimum, particularly the employment of stimulants combined with rectal or subcutaneous injections of hot saline solution. As soon as the surgeon has made up his mind whether to operate or not, it is well to administer a full dose of morphine and atropine, as the shock is often much diminished by the relief of pain; the pulse improves at the same time and the fæcal extravasation diminishes because the intestinal movements cease. Morphine, however, should never be given before the surgeon has made up his mind with regard to operation, because the improvement which follows is sometimes so marked that he is apt to leave the patient alone and so allow him to die of peritonitis. While the preparations for the operation are being made, the skin should be shaved and disinfected, and everything done so as to reduce to a minimum the time during which the patient is under the anæsthetic. These points are fully dealt with in connection with injuries to the abdomen (see p. 199). As regards the anæsthetic, the intravenous method of giving ether is advantageous in cases otherwise suitable for it. Spinal anæsthesia would

also be useful were it not that there is a possible danger of further extravasation of the contents of the bowel, as the result of moving the patient into the upright or lateral position in order to insert the solution into the spinal theca.

Unless there is a very clear indication as to the seat of the injury in the bowel, the abdominal incision should be made on one side of the middle line. No doubt in some cases, the ruptured intestine remains motionless beneath the badly brused abidominal wall and the more fixed portions of the bowel cannot of course move out of the way ; these cases may possibly form exceptions to the above rule, but in the great majority, even of punctured wounds, it is best to open the abdomen near the middleline. If it is necessary, in order to gain access to the injured bowel, the rectus may be subsequently divided transversely. In these cases the surgeon's first duty is to save the patient's life, and there should be no hesitation in enlarging the incision in such a way as to secure the best and easiest access to the injured parts. If there is a rupture of the bowel of any size, intestinal contents will almost certainly appear on opening the abdomen, or if not, will be seen on lifting up the omentum or pressing back the intestinal coils. The actual seat of rupture may be diagnosed to some extent by the nature of the material extravasated. Thus a sour-smelling fluid, containing undigested or partially digested food, probably comes from the stomach ; if it is chyme or mixed with bile, it comes from the duodenum ; if fluid, yellow and somewhat fæcal, from the small intestine ; and if semi-solid and darker, from the large intestine. If neither blood nor intestinal contents appear on opening the abdomen, it is well before closing the wound to pass the small intestine in review from the cæcum upwards, and the large bowel from the cæcum downwards in order to ascertain whether there is a rent in the peritoneal coat or even a perforation which has become temporarily plugged by prolapsed mucous membrane.

Non-penetrating wounds.—Even in rents of the serous or muscular coat alone, it is important to approximate the edges, because bacteria may pass through the wound and lead to peritoneal infection, and also because adhesion to other coils may occur and give rise to trouble subsequently.

When the mucous membrane is not perforated, it suffices to approximate the edges of the rent in the serous coat by a fine, continuous catgut Lembert's suture (see p. 223).

When there is either a tiny puncture into the lumen of the bowel, or when, as sometimes happens, there is a perforation at the end of a split of the serous and muscular coats, the mucous membrane must be tucked in and a double row of Lembert's stitches applied. It is not necessary to suture first the mucous and then the sero-muscular coats unless there is a widely gaping wound ; a double row of Lembert's stitches will suffice. There is practically no soiling of the peritoneal

cavity in these cases, so that nothing is required beyond gently mopping the bowel at the point of injury after the stitches have been put in.

Penetrating wounds.—The cases accompanied by fæcal extravasation are much more serious, and in them the only thing that gives the patient a chance is permanent closure of the wound in the intestine and thorough cleansing of the abdominal cavity.

(*a*) **In the small intestine.**—The remarks made regarding injuries of the stomach (see p. 241) apply equally to injuries of the first part of the duodenum. In some cases, the presence of free intestinal contents on opening the abdomen indicates at once that there has been an injury to the small intestine, and it is well to ascertain if the extravasation is diffuse or limited.

Cleansing the peritoneum.—When the injured loop is found, it is pulled out of the peritoneal cavity, packed off with hot abdominal cloths, and the injury to the bowel repaired. In cleansing the abdominal cavity in the simpler cases, it will suffice to mop up the extravasated intestinal contents carefully and thoroughly, and to cleanse the peritoneal cavity in the vicinity of the injury (see p. 244). If there is any doubt as to infection of the peritoneal cavity elsewhere, a long glass irrigating tube may be introduced into the abdomen in various directions so as to flush away any material that may be lodged there, but this should not be done until the area in the immediate neighbourhood of the perforation has been cleansed.

The most serious cases are those in which the extravasation has soiled the peritoneal cavity extensively, and in which the injured coil of intestine does not show at once but lies deep down or has moved away from its original position, thus necessitating a prolonged search for it. Even graver still are the cases of commencing peritonitis, because the distended intestines are not easily handled, the manipulation increases the shock, and the infection has got a firm hold.

In those grave cases in which there is extensive fæcal extravasation, and the affected coil is not immediately evident, there is a choice between two methods of procedure: either to separate the coils gradually until the injury is found and then to wash out the fæcal matter by introducing irrigating tubes into various parts of the abdomen, or to extend the incision in the abdominal wall and to *eviscerate* the patient at once. In our opinion the latter method is the one that offers the patient the better chance (see also p. 246). Manipulation of the intestine through an opening in the abdominal wall, especially when the intestine is inflamed, simply means increasing the shock, prolonging the operation indefinitely, imperfectly cleansing the abdominal cavity, and increasing the extravasation from the seat of injury during the manipulations. The fact that there have been a few recoveries under these circumstances does not invalidate this statement. In the evisceration method, all the intestines are at once turned out of the abdominal cavity,

and any further fæcal extravasation must take place outside it, while the injured coil is quickly exposed to view and much time is saved. Large hot abdominal cloths must be at hand for the reception of the intestines and these may be steeped in some bland sterile lubricant such as vaseline or pure paraffin, as, if they are dry, they tend to stick to the coils. The intestines can be turned out in a moment if the incision is sufficiently large and the edges are held well aside. They should be rapidly douched with hot saline solution (105° F.) so as to wash away any fæcal material on the surface, and then enclosed in the abdominal cloths.

Before proceeding further with the treatment of the intestine, the surgeon turns his attention to clearing out the extravasated fæces from the peritoneal cavity; in fact the assistant can be doing this while the surgeon is attending to the injured bowel. A strong stream of warm (105° F.), sterilised saline solution is directed into the peritoneal cavity, the edges of the incision in the abdominal wall being held apart so as to allow the fluid to escape freely; the whole abdomen is filled up and the solution is allowed to overflow freely, using many pints in the process. When the extravasated material has been thoroughly cleared out, it is well to mop up the fluid so as to remove any particles still floating in it; for this purpose it is best to employ gauze pads, which should not be used a second time. Special attention should be paid to Douglas's pouch and the lumbar regions.

The peritoneal cavity is finally filled up again with the hot saline solution, a cloth is thrown over the abdominal incision, and the extruded coils are examined. During the examination it is well to keep a stream of hot saline solution flowing over the intestines so as to wash away any fæcal material; to avoid the risk of this passing into the abdomen the patient should be turned slightly over on one side. Commencing at the lower end of the ileum, the intestinal coils are rapidly and methodically passed under review and irrigated, and the uninjured bowel is slipped back coil by coil into the abdomen until the damaged portion is reached. This is closed at once, by clamp forceps, wrapped up in an abdominal cloth of suitable size, and given to the assistant, who grasps the whole of the damaged coil in his hand and holds it well out of the way. The mesentery and the intestinal coils in its immediate neighbourhood are next irrigated thoroughly and the rest of the intestinal loops are passed rapidly under review, irrigated and returned into the abdomen if uninjured. Should a second injury be found, the coil is similarly isolated. In this way the intestines are cleansed effectually and the sound coils replaced in the abdomen, whilst the damaged bowel is shut off and further extravasation prevented.

As soon as all the sound coils have been returned into the abdomen, fresh hot abdominal cloths are packed over them so as to keep them in place. The above procedure takes some time to describe and sounds rather formidable, but it can be done with the greatest rapidity, and a

little reflection will show that it is the most satisfactory way of dealing with those extremely grave injuries.

An intestinal clamp is next applied to the bowel on each side of the injury, the portion of the gut between them being emptied by squeezing them and the whole loop is cleansed thoroughly. The assistant may now begin to stitch up the large wound by through-and-through stitches of silk-worm gut.

Treatment of the injured bowel.—This will vary with the seat and extent of the lesion. In the cases of which we are speaking, the edges of the rent are almost always irregular or contused and are very likely to slough, or at any rate to become the seat of development of bacteria, such as the colon bacillus, so that the stitches fail to hold, and septic peritonitis and possibly perforation may follow. Therefore, it will be necessary to remove the contused edges in all these cases so as to provide a clean-cut surface for union ; should the rent be extensive, this may entail so much narrowing of the lumen of the bowel when the incision is sutured that in most cases it is best to excise the damaged portion and make an end-to-end or preferably a lateral anastomosis. This is particularly the case when the rent extends through the mesenteric border of the intestine, the suture of which is by no means easy. Hence, we recommend that the rent in the intestine should only be sutured when it is comparatively small and is so situated that this does not result in constriction of the bowel. In some cases a short, longitudinal rent may be converted into a transverse one by bringing the extremities of the wound together, as is done in pyloroplasty or gastroplasty, thus actually increasing the lumen of the bowel (see p. 288) ; this, however, will not be feasible if the rent is a long one. When the small intestine is torn across from one border to the other, end-to-end anastomosis may be carried out if the two portions of the loop are equal in diameter ; and before doing this, it is well that the torn edges should be cut away so as to insure that the surfaces which are united are healthy. It is best, however, in most cases to remove a larger portion of the injured bowel and make a lateral anastomosis. If the large bowel is torn across and the edges of the tear cannot be sutured, the injured piece of bowel must be excised and a lateral anastomosis performed.

We have already referred on p. 223 to the *methods of uniting divided bowel*, and we need only make some remarks specially applicable to these injuries. We believe that simple suture without any accessory apparatus such as bobbins or buttons is the best, and that either end-to-end suture or preferably lateral anastomosis should be employed for the small intestine, and lateral anastomosis alone for the large. The junction of small and large intestine may also be accomplished by lateral implantation.

In recent wounds of the intestine the procedure is as follows : The portion to be excised is emptied of its contents and closed by intestinal

clamps (see Fig. 116) placed one on each side of the portion to be removed, and at a convenient distance from the proposed point of section; in order to get sufficient room, this should be at least four inches. The bowel is also clamped at a similar distance beyond the proposed point of section and is then cut across with a large pair of scissors and the damaged portion removed by cutting along its mesenteric attachment. The line of section of the intestine may be transverse or oblique; the latter is only necessary if it is proposed to make an end-to-end union, this obliquity increasing the lumen of the bowel when the cut margins are stitched together. It is not necessary to remove a V-shaped portion of the mesentery, as there is no thrombosis of its vessels as occurs in gangrene of the bowel, and by simply detaching the mesentery from the bowel there is no risk of injuring the blood-supply of the remaining intestine. Fig. 119 shows how the redundant mesentery should be treated; when only a small loop of intestine is removed, there is no

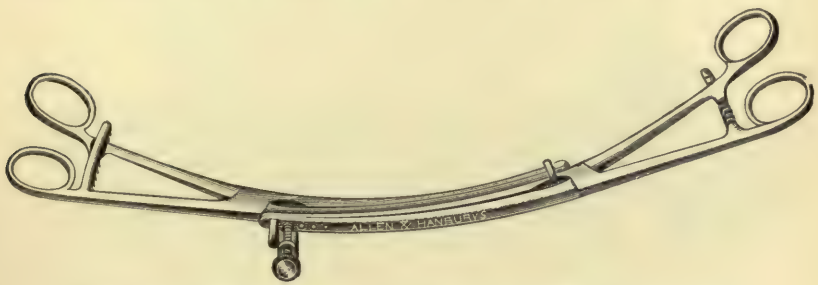


Fig. 116.—Lane's Intestinal Clamp arranged for Intestinal Anastomosis. This is the clamp shown in Fig. 95, but now arranged so that the divided ends of the bowel when grasped by them shall be side by side, as would be necessary for the performance of end-to-end anastomosis.

thick redundant piece of mesentery to stitch together afterwards. The individual vessels are picked up and tied as the bowel is detached.

End-to-end union.—For the purpose of uniting the divided ends the two ends of the bowel are brought together so that their open ends look forwards and, beginning at the mesenteric border, a line of Lembert's sutures is inserted about a quarter of an inch away from the cut edge. After about one-half of the bowel has been united in this way the stitch is tied and laid aside. The cut edges are now united by a continuous suture of catgut taking up all the coats of the intestine, but before this last suture is inserted the greatest care must be taken to see that the two segments of the intestine are in proper relative position. In order to make sure of this it is well to insert two temporary loops of silk through all the coats of the intestine, one at the convex border of the bowel and the other at the mesenteric attachment; these are given to an assistant to hold and they insure accurate coaptation of the two portions of the intestine and can be removed when the suturing is complete (see Fig. 117). The suture

should begin at the mesenteric border and be carried right round the gut. Especial care must be taken opposite the mesenteric attachment to see that the suture takes in the muscular coat, which is apt to retract in this situation. The suture may be inserted either with a curved or a straight needle.

When this suture has been inserted properly, accurate coaptation of the cut surfaces is assured and the intestinal canal is shut off. The Lembert suture is now continued outside this one (see Fig. 118). This suture should not be more than one-eighth of an inch away from the inner continuous one, otherwise a partial diaphragm will be formed

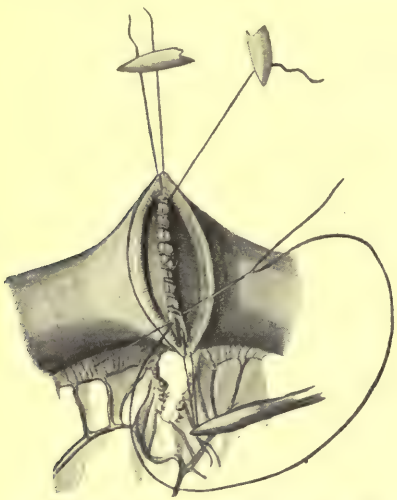


FIG. 117.—END-TO-END UNION OF THE INTESTINE. *Insertion of the deep suture.* The guiding sutures are seen in position. For the sake of clearness the clamps are omitted.

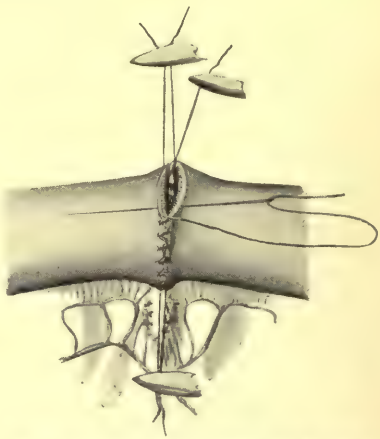


FIG. 118.—END-TO-END UNION OF THE INTESTINE. *Completion of the deep suture.* This takes up all the coats and is hæmostatic.

across the lumen of the bowel by the invaginated ends, and this may interfere with the passage of its contents.

The aperture in the mesentery must now be closed, and when the mesenteric border has been merely detached from the intestine, the projecting line of mesentery which is left when the ends of the bowel are brought together should be sewn together, as shown in Fig. 119. When a V-shaped piece has been removed the edges of the V are simply stitched together.

This completes the anastomosis; all that remains to be done is to remove the clamps, clean up the area of the operation, and drop back the loop into the abdominal cavity, which is then closed.

Some surgeons have strongly advocated the use of *omental grafts* around the line of union (see p. 224). In the majority of cases, however, there seems to be no reason for employing these grafts, whilst their use

certainly increases the length of the operation and may cause subsequent trouble from adhesions. They may be of advantage, however, when a large portion of bowel has been removed and there is a considerable amount of tension on the stitches.

Lateral anastomosis.—The method of end-to-end anastomosis can only be employed when the two segments of bowel to be united are of equal size. It cannot be employed when they are of unequal size or of irregular outline, as in the large intestine. Under these circumstances, it is best to invaginate and close the divided ends of the two portions, and then to perform a lateral anastomosis in the manner described on pp. 225 and 265. Many surgeons have indeed given up end-to-end union altogether and employ lateral anastomsis in the small intestine as well as in the large.

Artificial anus.—The question of the formation of an artificial anus or a fæcal fistula, which often arises in cases of intestinal obstruction, will

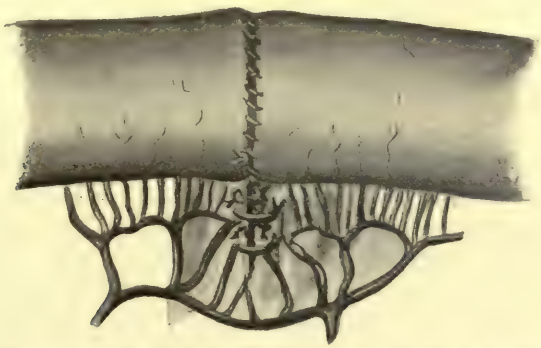


FIG. 119.—END-TO-END UNION OF THE INTESTINE.—*Completion of the anastomosis.* The guiding sutures have been removed and the opening in the mesentery sutured.

hardly ever require consideration in cases of wounded intestine when seen soon after the accident. In them the bowel is healthy on both sides of the injury, and there is no reason why an anastomosis should not be made at once.

(*b*) **In the large intestine.**—The above remarks concerning wounds of the small intestine apply also to those of the large. In the latter, however, the treatment is in some respects simpler, whilst in others it is more difficult. On the one hand, the damage to the bowel rarely extends to complete division, and, moreover, the size of the colon enables even large wounds to be sewn up without material interference with its lumen. On the other hand, the arrangement of the peritoneum in connection with the colon in certain situations makes it difficult to get proper access to the peritoneal coat and renders the manipulations necessary for the suture of large rents or complete divisions of the gut in these situations a matter of the greatest difficulty. This is especially the case in injuries of the ascending and descending colon, where all the procedures

may have to be carried out deep down in the abdominal cavity, and it may be difficult to draw up the intestine from the flanks so as to enable its posterior aspect to be got at satisfactorily. In these cases it is best to close both ends of the bowel and make a lateral anastomosis between the nearest suitable parts of the large intestine or between the ileum and the sigmoid flexure. In the latter case it is well to divide the ileum and sew up both ends and then make a lateral anastomosis between the proximal end and the sigmoid. If the patient's condition is very bad, this operation may be too protracted to be safe, and it is then wiser to divide the bowel across, invaginate the lower end with a purse-string suture, and put a Paul's tube (see p. 343) into the upper end. The continuity of the bowel may be restored at a later date.

After-treatment.—After the clamps have been removed, the area of operation cleaned up, and the united loop of intestine dropped back into the abdomen, the latter is flushed out once more with hot saline solution, and the abdominal incision sutured. The question of drainage in these cases is precisely similar to that in rupture of the stomach (see p. 247). Should there be any reason to doubt the vitality of the line of union, a small drain may be introduced down to the portion of intestine operated upon, so that should the anastomosis give way, a fæcal fistula will result instead of extravasation into the abdominal cavity. This is really the only circumstance under which drainage should be employed, as any attempt to drain the whole abdominal cavity when irrigation has not sufficed to cleanse it is futile. If drainage is employed, the peritoneum should be sewn up closely around the drain, otherwise vomiting after the operation may drive a coil of the small intestine through the opening into the layers of the abdominal wall, where it may become strangulated; this accident has happened more than once.

The treatment immediately after the operation should be mainly directed against shock, and will be similar to that described for cases of perforating wounds of the stomach (see p. 248). The after-treatment will also be largely on similar lines. When the small intestine has been united at or below its middle, there is no objection to administering food by the mouth, provided that it is easily digestible. The main point is to avoid undue movement of the intestines and particularly distension, which would endanger union by causing the stitches to cut through. Saline infusions, administered either continuously *per rectum* (about one pint per hour until four or five pints have been given, when they should be intermitted for three or four hours), or subcutaneously into the loose cellular tissue of the axillæ and beneath the breasts, are most valuable for the first twenty-four or forty-eight hours.

The union of the intestinal wall will generally be complete in from five days to a week; should perforation occur, it usually takes place about the fourth day, and it is generally quite safe to attempt to administer

purgatives after that period. When the injury has only affected the small intestine, the patient should have an enema daily, and if anything further is required, some saline mineral water may be administered; no violent purgatives should be employed at first. When there is much pain, fifteen grains of aspirin and twenty grains of bromide of potassium may be given *per rectum*, or heroin (gr. $\frac{1}{12}$ to $\frac{1}{8}$) may be administered hypodermically. It is well to avoid the use of morphine, so as not to paralyse the intestine. In injury to the large intestine enemata should not be employed.

TREATMENT OF INJURIES TO THE INTESTINE WHEN PERITONITIS IS ESTABLISHED.

It not infrequently happens—especially in gunshot wounds on the battle-field—that the patient is not seen until some long time has elapsed, and then the nature of the case is essentially different and it becomes practically a septic peritonitis of the very worst type. When once general peritonitis has become established there is no object whatever in operating in the great majority of cases, as there is practically no likelihood of cleansing the abdominal cavity and thus arresting the septic peritonitis, whilst the mere operation, involving as it does a great amount of shock from the handling of inflamed intestines, will probably prove fatal. As a matter of fact the best chance for the patient is to place him at absolute rest in the hope that the peritonitis may become localised and that an abscess, or—in the case of a perforating abdominal wound—a fæcal fistula, may form. At most a small opening may be made and one or more drainage tubes inserted.

CHAPTER XXII.

ACUTE INTESTINAL OBSTRUCTION.

Obstruction to the passage of fæces and other materials along the intestine may vary in degree from a slight difficulty to complete stoppage; in other words, the obstruction may be incomplete or complete. Two forms of intestinal obstruction are met with—namely, acute and chronic. These differ markedly not only in their symptoms, but also in their pathological conditions and must be discussed separately.

In cases which belong to the group of primarily acute intestinal obstruction, two important conditions are present: in the first place there is sudden and complete arrest of the passage of the intestinal contents, and in the second place the condition which gives rise to this arrest is one which also threatens the vitality of the portion of bowel involved. Hence the symptoms are urgent and severe and the prognosis is grave.

The *symptoms* vary somewhat according to the cause of the obstruction, but the following is the usual course of events: Previous to the onset of the obstruction, the patient has usually been in perfect health, and then, after some cause such as a severe strain or violent movement or sometimes without any apparent cause, he is suddenly seized with acute abdominal pain, usually referred first to the region of the umbilicus or the epigastrium, but soon accompanied by intermittent attacks of colic. At the onset there may be marked collapse and pallor, with a small and thready pulse. Vomiting occurs early, but gives no relief and there is constant nausea and eructation. The material vomited at first consists of the contents of the stomach together with bile. There is usually complete constipation from the first, though sometimes the contents of the lower bowel may be evacuated; neither the solid nor the gaseous contents of the intestine pass on, and one peculiarity of the constipation is that it is at once evident to the patient himself. In ordinary cases of constipation the patient only gradually becomes aware of the fact that the bowels are not acting; but here from a very early stage he feels that there is some difficulty in the onward passage of flatus

and fæces, and that if only they could pass he would be relieved. There is no tenesmus. The temperature is subnormal and usually remains so throughout, although it may rise if the patient lives long enough for peritonitis to set in. Thirst is often very marked.

The abdomen in the first instance is flaccid, and there is usually no tenderness on pressure in the early stages. As the case progresses, the vomiting continues, but the nature of the vomited matter changes, becoming foul and fæcal in odour and consisting of the decomposed contents of the intestine above the obstruction. The putrid character of the vomit becomes more marked and it is then termed stercoraceous. Very distressing hiccough sets in and the abdomen becomes distended, sometimes so greatly as to interfere with respiration and embarrass the heart. The patient may recover somewhat from the initial collapse, but gradually passes into an exhausted condition, the pain and other symptoms continue, and he usually dies within a period varying according to the cause of the symptoms from a few hours to a week. These symptoms indicate an obstruction to the passage of the contents of the intestine, accompanied by some lesion of the bowel wall.

Diagnosis.—Perhaps the condition most commonly mistaken for acute intestinal obstruction is the onset of *acute peritonitis*, such as follows perforation of the appendix, or even sudden acute appendicitis without perforation, but the symptoms will be found to differ widely when critically examined. In peritonitis, the initial collapse is usually not so severe, although it may be well marked after a perforation of the appendix or of the stomach. The abdomen becomes distended much sooner than in acute intestinal obstruction, and there is great tenderness which at first is often localised to the site of the initial lesion, but soon becomes diffused over the abdomen. The temperature may rise almost from the first. The vomiting is not such a distressing feature, and usually passes off and does not return for some time, while obstructive symptoms are not prominent at first, the patient being often able to pass flatus. Other possible conditions which may have to be considered on first seeing a case of this kind are the *passage of a gall-stone or a renal calculus.* Here the symptoms are very acute, but there is not the same collapse, while the character of the pain is different, being more severe and of a distinctly colicky type from the first, and located in some special region; other special symptoms are also present and the pain in these cases is not referred to the umbilicus. Among other conditions which may give rise to somewhat similar symptoms are *thrombosis of the mesenteric vessels* and *acute pancreatitis.* Further, the possibility that the symptoms are due to *lead colic* or to the crises of *tabes dorsalis* should be borne in mind, and the patient should be examined for other evidences of these affections.

Various pathological conditions may lead to this train of symptoms, and it is often impossible to say exactly what is the state of matters inside the abdomen. The most common conditions are strangulation of a piece

of the bowel by a band, internal hernia, external hernia, volvulus, or acute intussusception. Somewhat similar symptoms may also arise from blockage of the canal by a foreign body, *e.g.*, a gall-stone, or from acute kinking of the bowel.

Strangulation of a portion of the intestine under a band is not at all uncommon, and if there is a history pointing to a previous attack of

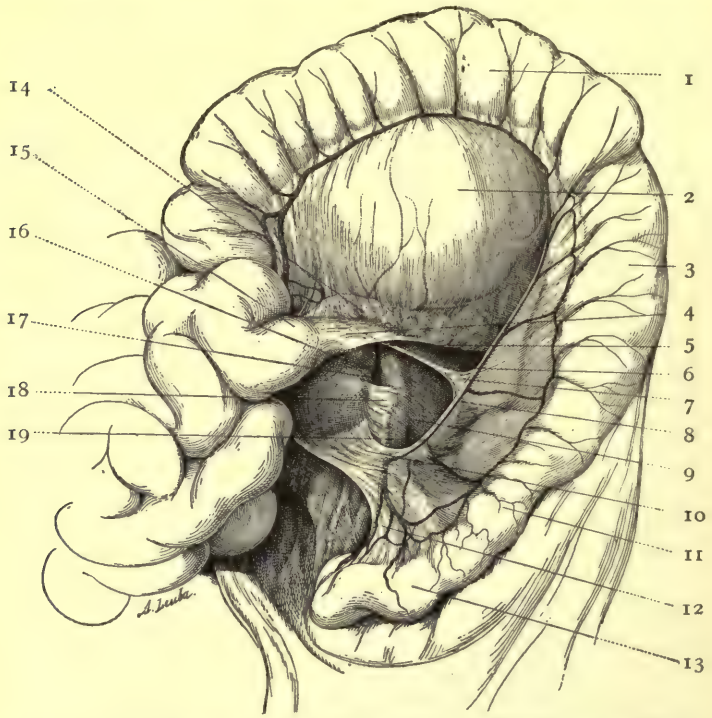


FIG. 120.—THE ANATOMY OF THE PARTS CONCERNED IN HERNIA INTO THE FOSSA DUODENO-JEJUNALIS (TREITZ'S HERNIA). 1, Transverse colon. 2, Transverse meso-colon. 3, Descending colon. 4, Upper boundary of duodenal fossa. 5, Lower border of pancreas. 6, 7, 8, Vascular arch of Treitz, consisting of the arteria colica sinistra and the inferior mesenteric vein, constituting the anterior boundary of the para-duodenal fossa. 9, Para-duodenal fossa. 10, Inferior boundary of the para-duodenal fossa. 11 and 13, Sigmoid colon. 12, Meso-sigmoid. 14, Pancreas. 15, Small intestine. 16, Duodeno-jejunal junction. 17, Duodenum. 18, Inferior boundary of the duodenal fossa. 19, Aorta.—(*Poirier.*)

appendicitis or peritonitis the probability of this being the cause of the trouble is very considerable. The most acute forms are usually due to this condition. These bands may be the result of peritonitis uniting one portion of the intestine to another or to the abdominal wall, or causing adhesions of the omentum; as the result of long-continued vermicular movements of the bowels they become stretched and form loops beneath which the intestine may be strangulated. In other cases the band may be due to the attachment of such structures as the appendix or Meckel's

diverticulum to the intestine, mesentery, or abdominal wall; or again, without any previous peritonitis, a long Meckel's diverticulum or an appendix may coil itself around a portion of the intestine and so produce strangulation. Again—possibly following some injury to the abdomen or some abdominal operation—an aperture may be formed in the omentum or the mesentery, through which intestine may pass and become strangulated.

The portion of bowel strangulated beneath a band is practically always some part of the small intestine, usually the lower end of the ileum, and it is very important to remember this in searching for the obstruction. The most distended coils generally accumulate in the middle line at or below the umbilicus, and the seat of strangulation is very commonly to the right of this, and somewhere in the neighbourhood of the cæcum.

Similar symptoms may be caused by *herniæ*, both external and internal, and the hernial apertures should always be investigated before operating. The question of strangulated external hernia is considered in connection with hernia in general (see Chap. XXIX). Much more rarely there may be an *internal hernia*. Among the common seats of true internal herniæ the following may be mentioned: Hernia may occur *through the foramen of Winslow* into the lesser peritoneal cavity, but this is extremely rare. *Treitz's hernia or hernia into the fossa duodeno-jejunalis* (see Fig. 120) is more common. There are two forms of this hernia, termed right- and left-sided. In the 'right-sided' cases the bowel passes into a fossa formed by a fold of peritoneum behind the junction of the duodenum with the jejunum, and although in the normal state this is a depression only admitting the thumb, it may become gradually dilated until a large loop of the intestine can pass into it. The other form is 'left-sided,' and is situated in the meso-colon, and is bounded by the vascular arch formed by the left colic artery and the inferior mesenteric vein as they come in contact and cross each other. Here it is impossible to enlarge the opening by cutting. The sac in these cases has a narrow orifice, and as the hernia enlarges, this travels downwards and to the right, so that finally it may lie in the neighbourhood of the cæcum. The inferior mesenteric vein lies in the anterior margin of the neck of the sac, and the left colic artery above and in front of it, and should it be necessary to operate on a case of this kind, the neck of the sac can only be safely divided in the downward direction.

A very rare form of internal hernia, known as the *inter-sigmoid* variety, occurs in the fossa formed by the layers of the sigmoid meso-colon situated about the bifurcation of the iliac vessels and to the left side of the sigmoid meso-colon. A fourth form is *peri-cæcal hernia*, which may be of three varieties—namely, the ileo-colic form which occurs in the fossa situated in the angle between the ileum and the commencement of the ascending colon, the ileo-cæcal situated further back, and the sub-cæcal behind the cæcum. *Diaphragmatic hernia*, usually occurs through

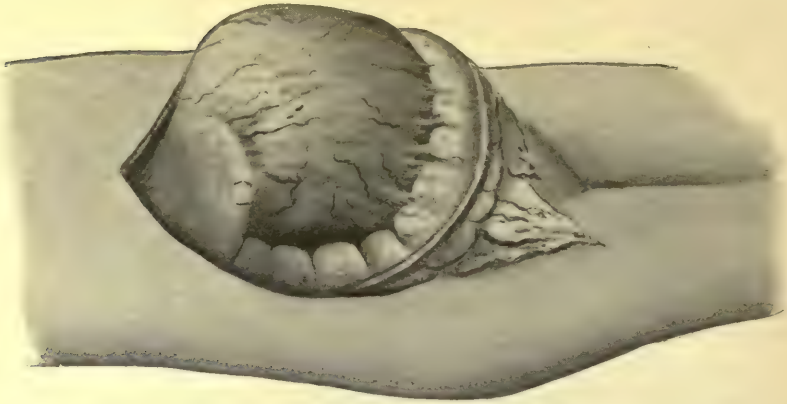


FIG. 121.—LEFT-SIDED DUODENAL HERNIA. This is the commoner form of Treitz's hernia. The drawing shows the appearances seen on opening the abdomen. The hernia is seen in its sac protruding between the stomach and the transverse colon.

FIG. 122.—TREITZ'S HERNIA. The same hernia as the one in the preceding figure. The transverse colon has been turned upwards and to the left, exposing the opening into the sac. The coils of intestine entering and leaving the neck of the sac are well seen.

an opening in the diaphragm which is either congenital or may be the result of an injury. Internal herniæ are exceedingly rare, and are about the last things to be looked for when the abdomen is opened on account of symptoms of internal strangulation.

Another condition which may give rise to similar symptoms is *volvulus of the small intestine or the cæcum.* This is, however, rare as compared with *volvulus of the sigmoid flexure.*

A condition that may also lead to similar symptoms is *acute kinking of the bowel* from contraction of a band (see Fig. 123) or from adhesions or compression of the gut by inflammatory matting of the intestines (see Fig. 124). This condition is usually more chronic in its onset and does not begin with the collapse and other acute symptoms characteristic of internal strangulation.

FIG. 123.—ACUTE KINKING OF THE INTESTINE CAUSED BY THE TRACTION OF A BAND. The traction produced enough kinking to give rise to complete obstruction.

Acute intussusception is another cause of these symptoms, but it differs very considerably in some respects from the foregoing forms of acute intestinal obstruction, and the majority of cases can be diagnosed before operation. It seems therefore more convenient to consider it separately (see Chap. XXIII.).

There is still another group of causes of acute obstruction that require mention—namely, *blocking of the bowel by foreign bodies*, of which the most common is a gall-stone. Here the symptoms are usually not so acute, the pain is not so great, and the other symptoms—especially the collapse in the early stages—are not so severe as in strangulation. The possibility of this occurrence must, however, be borne in mind in operating for acute intestinal obstruction.

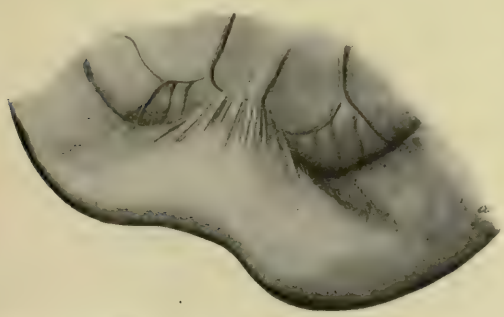


FIG. 124.—INTESTINAL OBSTRUCTION CAUSED BY A 'ROLLED-UP KINK' DUE TO INFLAMMATORY ADHESIONS.

Changes produced by the obstruction.—As a result of the constriction

of the bowel, changes take place both in the strangulated portion and in the intestine above. *The changes at the seat of constriction* concern the circulation in the loop of intestine involved. The first effect of the constriction of the blood-vessels is engorgement of the veins, followed by œdematous infiltration of the loop and exudation of fluid into the peritoneal cavity or the sac of the hernia; hæmorrhage may also occur into the intestinal wall. The constricted loop is at first swollen, glistening, and purplish. As the swelling increases, the constriction becomes tighter, until finally the circulation in the intestinal loop may be entirely arrested. The result is that the portion of intestine involved dies unless the constriction is relieved; the loop loses its glistening appearance, becomes flaccid and soft, swells up and becomes foul. The gangrene first occurs and is most marked at the actual seat of constriction. Perforation of the intestine occurs as a result of the gangrene, and generally takes place at the seat of the constriction. If, however, the constriction is relieved before these changes have occurred, the intestine gradually resumes its normal condition.

The intestine above the constriction becomes dilated and often attains a large size from the development of gas and the accumulation of foul fluid within it. It is also congested, so that it can usually be easily distinguished from that below not only on account of its dilatation, but on account of the marked congestion of its walls. On the other hand the intestine below the obstruction is pale and empty. The fluid contents of the intestine above the obstruction rapidly undergo decomposition, and furnish the so-called 'fæcal' vomit, which is really putrefying intestinal contents. After a time, paralysis of the bowel above the constriction results, so that, even though the obstruction is subsequently relieved, the paralysed intestine may not drive on its contents.

The causes of death in acute intestinal obstruction are gangrene of the bowel, peritonitis, and stercoral auto-intoxication. Even though the strangulation be relieved by operation, death may still occur from peritonitis, from perforation of the affected loop, from paralytic distension or kinking of the intestine, from auto-intoxication, or from septic pneumonia resulting from the entrance of putrid vomited matter into the air-passages.

Diagnosis of the situation of the obstruction.—It is not only difficult to diagnose the nature of the obstruction before operation, but also to determine its position. Acute obstruction more often involves the small intestine than the large, obstruction involving the colon—with the exception of volvulus—being usually chronic; even in the latter, the severe symptoms often do not set in at once. When the small intestine is affected, the pain usually begins immediately and is very severe, whilst vomiting commences earlier and is more troublesome, and there is generally more severe collapse than when it affects the large bowel. On

the other hand, meteorism is a more prominent and earlier feature in obstruction involving the large intestine, and may reach an enormous degree in a volvulus of the sigmoid flexure. Evidence of movement of dilated coils can seldom be observed in acute obstruction, but is often seen in the chronic form.

It is practically impossible to make a diagnosis as to the actual seat of obstruction in the small intestine. It has been said that the higher up in the bowel the obstruction has occurred, the less is the amount of urine secreted; but that really depends rather upon the tightness and suddenness of the strangulation than upon its actual seat.

TREATMENT WHEN THE PATIENT'S CONDITION IS GOOD.

In acute intestinal obstruction there is no medical treatment; the only thing that can give the patient a chance is immediate operation. It is true that a few cases in which the symptoms have pointed to acute intestinal obstruction and which have not been operated upon have recovered, either when left entirely alone or under the administration of opium, but these are extremely few in number and the diagnosis is exceedingly doubtful. It would be most reprehensible not to operate on a patient because there is an infinitesimal chance that recovery might occur without operation.

As soon as the diagnosis of obstruction has been made, operation should be carried out forthwith and quite independently of the ability to diagnose the seat or nature of the obstruction.

The only question of treatment preliminary to operation has reference to *the administration of morphine*, which the medical attendant is sometimes tempted to prescribe as soon as he is called in and before he has made his diagnosis. Given in this way, morphine is most dangerous, because the character and urgency of the case may be masked and operation may be delayed too long. When, however, the diagnosis has been made, and while preparations are going forward for the operation, there is no objection to the administration of gr. $\frac{1}{8}$ to $\frac{1}{6}$ of morphine with atropine (gr. $\frac{1}{120}$ to $\frac{1}{100}$) and scopolamine, hypodermically, as it relieves the urgent symptoms, causes diminution of the vomiting and the shock, and improves the patient's general condition—sometimes to a surprising degree—besides facilitating the anæsthesia. Morphine should, however, not be given—even as an immediate preliminary to operation—when obstruction has lasted for some time, because it may increase the already existing paralysis of the bowel and therefore diminish the patient's chance of recovery after operation.

In making preparations for the operation it must be borne in mind that the patient is collapsed and the operation—which must involve considerable manipulation of the intestines—will indubitably tend to increase the shock. Hence all the precautions mentioned in Vol. I.

p. 117 and in connection with rupture of the intestines (see p. 199) should be rigorously carried out. The operation should be performed quickly, and everything possible—shaving, purification, and the threading of needles for intestinal suturing—should be done before the administration of the anæsthetic is begun.

A most important point, which should never be omitted in any case of acute intestinal obstruction, is to *wash out the stomach* (see p. 236) before the anæsthetic is begun. In these cases the stomach contains a quantity of most offensive and putrid material, and vomiting is apt to be profuse under the anæsthetic ; the material vomited not infrequently passes into the air-passages in considerable quantity causing asphyxia or, more frequently, septic pneumonia.

The room and table should be warm, and as the coils of intestine are likely to escape from the abdomen as soon as it is opened, plenty of hot abdominal cloths must be at hand to wrap them in. The question of the anæsthetic is important. Spinal anæsthesia (see Vol. I. p. 486) is valuable in these cases, as the muscular relaxation is very perfect. Intravenous ether anæsthesia (see p. 32) is possibly an advantage as it gives good muscular relaxation, but great care must be taken not to give too much saline solution as, owing to the weakened state of the circulation and the heart, a widespread œdema of the lungs may be produced, which may cause a fatal result. We are convinced that it is bad practice to introduce more than 2 or 2½ pints of saline into the patient by this means, even if the operation is prolonged. Once this amount has been administered, the open ether method should be substituted if the operation has not been completed. If the anæsthetic is administered by inhalation throughout or if spinal anæsthesia is employed, continued infusion of saline solution into the subcutaneous tissue of the axillæ, beneath the breasts, or into the rectum should be given.

There are three chief points to be considered in carrying out the operation—namely : the finding of the obstruction ; its relief ; and the treatment of the strangulated intestine.

THE FINDING OF THE OBSTRUCTION.—In practically all cases the abdominal incision should be made slightly to one side of the middle line as already described (see p. 215). It is never safe to trust to local symptoms, such as pain or swelling, as an indication of the position of the obstruction, unless possibly in the case of an intussusception in which a distinct lump can be felt. The incision through the abdominal wall should be free, and the greater part of it should lie below the umbilicus, but in all probability it will be necessary to extend it above it. The seat of obstruction seldom appears immediately beneath the opening ; the bowel usually found there is a dilated coil, and, as handling the intestines in these cases gives rise to considerable shock, a small incision is practically useless, and the opening should be large enough to admit the hand freely before the search for the obstruction is undertaken.

As soon as the peritoneal cavity has been opened, distended coils present in the wound, and these are inspected to ascertain whether they are small or large bowel, as this at once gives a guide to the position of the obstruction. Should the case be one of volvulus, the large distended loop will be evident immediately on opening the abdomen. If serous fluid escapes, this usually indicates severe strangulation, and the presence of lymph on the surface of the intestine indicates peritonitis and possibly perforation. The finger should first be swept round the inside of the abdominal wall over the orifices of the various openings through which external herniæ take place, particularly the obturator foramina. It is next passed down to the cæcum to ascertain whether it is empty or dilated; if it is empty the obstruction must be in the small intestine, whereas if it is distended the large bowel will be the seat of the mischief. The above examination is about all that can be made through a three- or four-inch incision, which is the length usually made in the first instance.

The incision should now be enlarged with scissors, generally in the upward direction. As the incision is enlarged and the edges of the wound are held aside, it will be impossible to prevent the escape of intestinal coils through the opening, and the search for the obstruction will be much facilitated by allowing them to escape into hot abdominal cloths which cover them up as they protrude. It is not usually necessary to pull out more coils of intestine than protrude spontaneously; the distended coil is gently pulled on to see if it is held somewhere, and if so, by following this downwards, the seat of obstruction will be encountered. It is, however, best to look for collapsed intestine and to follow it up to the constriction, rather than to follow the distended bowel down. It is not only easier to do, but also there is not so much chance of injuring the bowel.

This method of allowing the intestines to escape without actually eviscerating the patient is far superior to a blind search made by plunging the hand into the abdomen, or by pulling on individual coils of bowel. The hand in the abdomen is an absolutely uncertain instrument which bruises dilated coils and sometimes even ruptures the peritoneal coat without any certainty that the search is being made in the direction of the obstruction. Moreover, by pulling upon the coil of distended bowel, perforation at the seat of obstruction may be actually produced. The only objection to allowing the coils to escape in this manner is the difficulty experienced in putting them back when they are greatly distended. In most cases, however, it is well to empty the coils before any attempt is made to return them into the abdomen (see p. 341), and this difficulty is thus overcome. The greatest gentleness should be observed in the manipulations, and the surgeon should have plenty of room, and should never attempt to pull on intestine or work in the dark. It is becoming a favourite practice to receive the protruded coils into hot cloths smeared

with sterilised vaseline or pure paraffin in order to avoid damage to the epithelial coat.

RELIEF OF THE OBSTRUCTION.—After the obstruction has been found, the intestines should be packed out of the way and the state of matters carefully examined. Most frequently the cause of the strangulation is a band or an aperture in the omentum or mesentery, and if a band is found it must be divided. In long-standing cases the band itself may have become practically gangrenous and so soft that it tears through, and the obstruction is relieved immediately. If not, the band should be divided in the usual manner by inserting beneath it either a director or the finger, upon which it is divided with a herniotome. The two ends of the band should be seized in forceps and each end should be cut away as completely as possible after division, so as not to leave any loose tags which might adhere again and form fresh bands ; a thick band should be ligatured before division. Omental adhesions should be dealt with in a similar manner. When the constriction is due to the adhesion of some structure, such as the tip of the appendix or Meckel's diverticulum, it may suffice to detach the adherent end if the patient's condition is bad. If, however, the patient's condition will allow a prolongation of the operation, it is well to remove the diverticulum or the appendix in the usual manner (see Chap. XXVI.) so as to avoid recurrence of the trouble. When, however, the constriction is formed by a Meckel's diverticulum twisting itself around the intestine, this structure must be removed in spite of the extra time required, otherwise the obstruction will very probably recur.

Any aperture in the omentum or mesentery should be dilated or enlarged by tearing, so as to permit the reduction of the herniated intestine, after which the slit is sewn up. Acute kinking of the bowel from adhesions is rectified by careful detachment of the adhesions, which is often a matter of extreme difficulty. If the bowel is adherent to the abdominal wall, the best plan is to leave a piece of the parietal peritoneum adherent to it rather than to attempt to peel it cleanly off the intestine, as the latter structure may easily rupture. If one portion of the intestine is adherent to the other, it will be necessary to separate the two and in doing so the greatest care is required to avoid tearing the bowel.

Should no band or other common cause of strangulation be found, the various seats of internal hernia should be carefully examined. It is almost impossible to relieve strangulation at the foramen of Winslow when the hernia is of any size, because there is no part of the foramen that can be divided safely with the knife so as to relieve the obstruction. Hernia through a slit in the diaphragm is also very difficult to treat ; peri-cæcal herniæ generally pull out easily, and we have already referred to Treitz's hernia (see p. 333).

TREATMENT OF THE INTESTINE.—The treatment of the bowel after relief of the strangulation will depend upon its condition

and also upon that of the intestine above the constriction. The following conditions may be considered :—

1. When the constriction is slight.—In many cases the constriction has not been tight—indeed, it may become released during the manipulations—the bowel has not been materially damaged, and on the relief of the constriction, the contents pass on freely from the intestine above. Here no further treatment is required and the abdomen may be closed in the usual manner.

2. When the strangulation is severe but the bowel may recover.—In these cases the bowel above the constriction may remain distended in spite of the relief of the strangulation, the contents may not pass on properly, and the patient may be poisoned by them. This difficulty is due partly to the over-distended state of the bowel above and the consequent absence of proper peristaltic action, and partly to the fact that, as a result of over-distension, kinks have occurred in the bowel at and above the obstruction, which still remain after the constriction has been relieved. Under these circumstances it is absolutely essential to evacuate the bowel above the seat of obstruction before the abdomen is closed; unless this be done, the obstructive symptoms continue and the patient dies partly from them and partly from stercoral poisoning.

Evacuation of the bowel above the strangulation.—The coils of intestine, with the exception of that immediately above the seat of obstruction, are returned into the abdomen, and the wound is protected by hot sterilised towels which retain the coils in the abdominal cavity. The coil which has been kept out is packed round with warm abdominal cloths so as to prevent soiling of the peritoneal cavity. A long piece of india-rubber drainage tube (No. 24) is taken and an opening, just large enough to allow the insertion of the tube and nothing more, is made in the convex border of the loop, the bowel being compressed above and below while the opening is being made, and the end of the drainage tube inserted into it. The other end of the tube is placed in a suitable receptacle and then the compression is relaxed and the contents of the bowel are allowed to flow away. Instead of the india-rubber drainage tube, a glass tube, six to eight inches long, cut obliquely at one end and provided with a flange at the other end, may be used. To the flanged end, a length of thin rubber tubing is attached, and serves to carry away the contents to a suitable receptacle (see Fig. 125). As a rule, only a small quantity escapes —that is to say, only the amount in the loop punctured and up to the kink above. When the flow ceases, the drainage tube should be gradually pushed upwards along the bowel so as to pass into the next coil above, and this is continued until satisfactory evacuation of the intestine above has been obtained. If a glass tube is used, the contents of the coil may be gently ' milked ' downwards, and as one portion is emptied, the coil itself may be threaded over the surface of the tube, and in this way several feet of intestine may be evacuated through one incision. During this period the

exposed coils are kept warm by covering them with hot abdominal cloths. The object of using a tube, instead of simply making a small opening, is to allow of the evacuation of the coils above, which may not empty themselves at once through the opening. The tube will pass onwards more easily if lubricated with sterilised vaseline before its insertion. Before completing the operation the surgeon must be satisfied that the intestine has been thoroughly evacuated, and it may be a matter of an hour or more before it seems safe to close the opening and the abdomen. In many cases, this evacuation of the upper part of the bowel will make

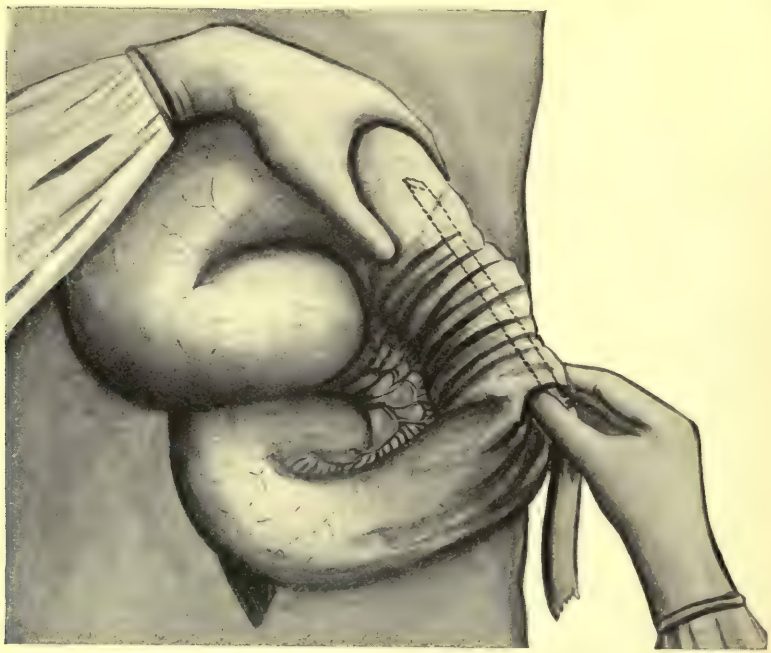


FIG. 125.—EVACUATION OF A DISTENDED LOOP OF BOWEL IN INTESTINAL OBSTRUCTION. The drawing shows how the glass tube is pushed on into successive loops by folding up the wall of the loop that has been emptied.

all the difference between recovery of the patient and failure of the operation.

When the surgeon is of opinion that the coils have been sufficiently emptied, the tube is withdrawn, the intestinal walls above and below the small opening are temporarily approximated by clamps, and the incision itself rapidly closed with a fine continuous Lembert suture. A single row will suffice if the stitch is commenced and terminated about a quarter of an inch beyond the extremities of the incision. The bowel is then carefully cleaned up, the loop dropped back into the abdomen, and the closure of the abdominal wall proceeded with (see p. 215). Fig. 126 shows

a most useful form of intestine guard when sewing up the abdominal wall in these cases.

3. When the bowel is not likely to recover.—When the constriction has lasted for some time or has been very tight, gangrene of the affected loop is very likely to occur. The strangulated intestine will be black, will have lost its glistening character, and will be soft and tend to collapse when the constriction is relieved. Under these circumstances the coil cannot be returned into the abdomen. If the patient's condition is good, the coil should be excised, and a lateral anastomosis performed. The line of section of the bowel should be made at least six or eight inches on each side of the seat of constriction. The enterectomy is done in the usual manner (see p. 324). In these cases it is advisable to take away a V-shaped piece of the mesentery, both because the vessels may have become thrombosed and also to avoid leaving a large projecting piece of mesentery to which bowel is very apt to become adherent. When there is much distension of the coils, it will be advisable to empty them before making the anastomosis. In these cases it may be necessary to excise a

FIG. 126.—INTESTINE GUARD. This instrument tapers from end to end and is concavo-convex. The narrower end is slipped into the abdomen beneath one end of the wound with the convex surface of the guard uppermost. The intestines are thus kept easily in place and the abdominal parietes are readily sutured without any risk of the bowel being injured. As the closure progresses the instrument is gradually withdrawn.

large piece of intestine, and in order to provide for efficient evacuation of the coils above the anastomosis, a Paul's tube or a rubber drainage tube may be inserted for a time into the proximal loop of the coil in which the anastomosis has been done (see Fig. 127) and the bowel attached to the abdominal wall. If a rubber tube or catheter (size 15) is used, it may be fixed in position in a manner similar to that employed in Kader's method of performing gastrostomy. When the distension has subsided, a plastic operation may be required to close the fistulous opening.

In cases in which the patient's condition is bad, the gangrenous portion is brought outside the abdomen, clamps are applied on each side, the gangrenous part is cut away, and a Paul's tube tied into each open end. The bowel is then fixed to the abdominal wall with safety-pins, which pick up the sero-muscular coat above and below the tube (see Fig. 128), and the abdomen is closed. In these cases it is not advisable to attempt to unite the ends of the bowel.

This does not, however, complete the operation, for the surgeon must see that the upper portion of the intestine is evacuated efficiently through the Paul's tube just as in the previous case. This may sometimes be done by filling up the tube with water and so forming

a syphon arrangement; or a smaller india-rubber tube may be introduced through the open end of the glass one and may be pushed into the coils of intestine above, or an attempt may be made to suck out the contents of the bowel with an evacuator. The surgeon must be satisfied that the contents of the upper portion of the intestine are escaping freely before he leaves the patient.

The ring of intestine constricted by the suture round the Paul's tubes usually sloughs in about three days and then both the tubes become loose and must be removed. By that time sufficiently firm adhesions

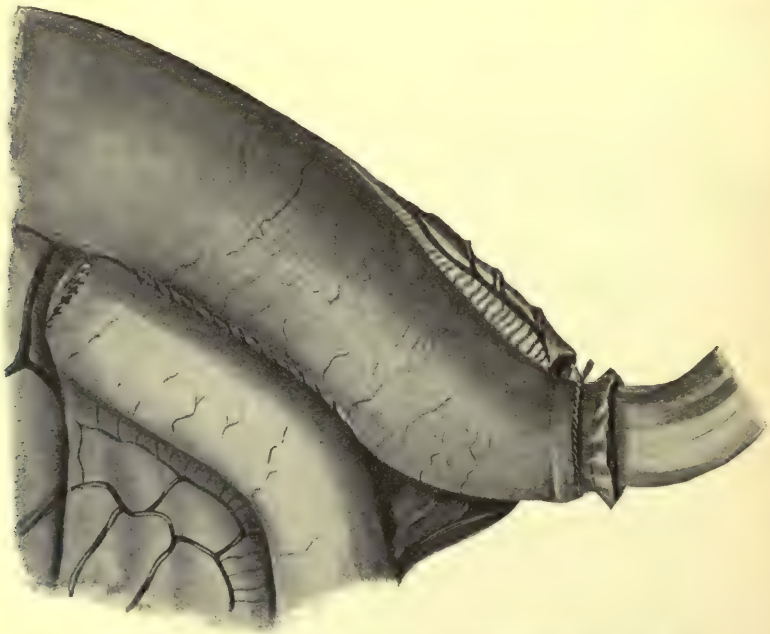


FIG. 127.—TEMPORARY INTESTINAL DRAINAGE AFTER ENTERECTOMY FOR ACUTE OBSTRUCTION. A portion of the bowel has been resected and a lateral anastomosis established. The end of the distal portion of the bowel has been invaginated and closed, while into the open end of the proximal portion a Paul's tube has been tied in order to ensure proper drainage of the intestinal contents.

have occurred to prevent the entrance of the contents into the abdominal cavity and there is little risk of septic infection. When the patient has recovered, the closure of the artificial anus must be undertaken (see Chap. XXXI.). When the opening is in the small intestine this must be done comparatively early, for two reasons: in the first place, because nutrition may be seriously interfered with by the escape of the contents of the small intestine, and in the second place, because these contents are very irritating and cause excoriation of the abdominal wall.

After-treatment of cases of acute intestinal obstruction.—Little need be said about the after-treatment of these cases, as it does not differ in any

material manner from that appropriate to intestinal injuries (see p. 328). As a rule, even greater attention has to be paid to the question of stimulating the patient freely, on account of the severe auto-intoxication that occurs as the result of the long-continued absorption of putrefying intestinal contents, and another point of the greatest importance is to avoid the use of opium or morphine as much as possible. It is more important in intestinal obstruction than in any other case to avoid anything leading to paresis of the intestine which would inevitably promote the auto-intoxication from which the patient has already suffered so much. In all cases, therefore, whether the intestine be returned unopened, whether it be merely evacuated and returned, or whether a resection has been performed, the administration of opium should be restricted entirely to the relief of severe pain. The patient should be kept in the semi-recumbent or upright position. Saline solution should be administered continuously *per rectum* or subcutaneously, and pituitary extract may be given hypodermically. After twenty-four hours, the action of the bowels should be promoted, enemata being given daily, whilst a saline aperient may be given by the mouth at the end of the fourth or fifth day. From the time that the bowels become well opened, the patient's condition generally improves with great rapidity.

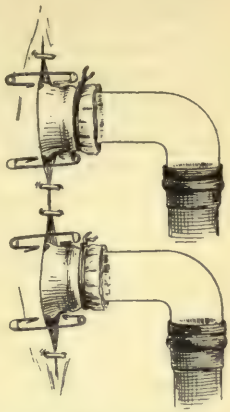


FIG. 128.—PAUL'S TUBE AS USED TO ESTABLISH AN ARTIFICIAL ANUS. The bowel has been cut across and a tube tied into each end. The gut is prevented from shifting its position by the safety-pins thrust through its sero-muscular coats. Two stitches bring the skin together between the tubes and thus shut off all communication between the two ends of the bowel.

The principles guiding the question of feeding will be the same as those laid down for the treatment of intestinal injuries (see p. 328). When an artificial anus has been made and the patient recovers, the case becomes one of artificial anus which must be treated on the lines suitable for that condition (see Chap. XXXI.).

VOLVULUS.

Volvulus may occur in the small intestine or in the cæcum, but it is rare in those situations. In the case of the small intestine it may occur in infants, owing, apparently, to congenital narrowing of the mesentery, and then generally involves the jejunum and ileum and also the ascending colon. In later life it is generally situated at the lower end of the ileum, not infrequently after the coils have been present in a hernial sac for some time and the mesentery has undergone alterations, especially narrowing. Volvulus may also occur in connection with mesenteric cysts or tumours.

The symptoms are usually very severe, with marked collapse and early and great distension of the abdomen. Volvulus of the cæcum is quite rare and is generally associated with imperfect fixation of the ascending colon. The most common seat of volvulus is in the sigmoid flexure, and we shall therefore only refer to that situation, as the symptoms and treatment are very much the same wherever it occurs.

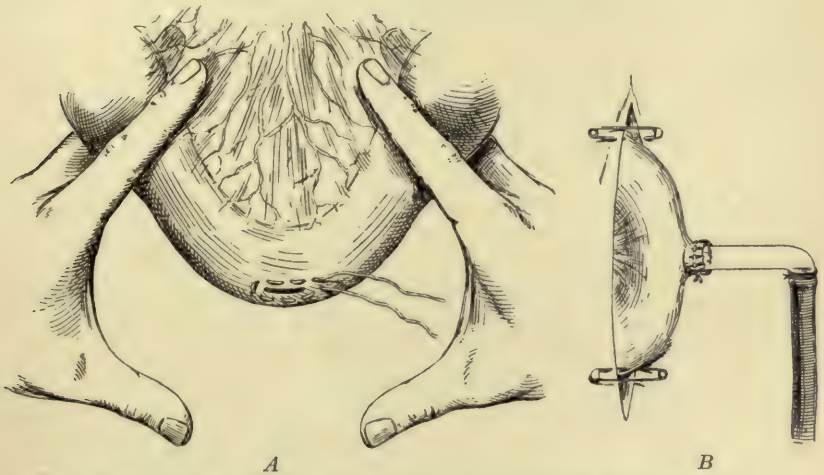
In volvulus of the sigmoid flexure, there is a twist of the sigmoid loop, varying from a half to one or more complete circles, and the result is interference with the circulation of the blood through the meso-sigmoid, the amount of interference being directly proportionate to the severity of the twist. The torsion also interferes with the passage of intestinal contents, and complete obstruction follows. These is subsequently an enormous development of gas and great distension of the abdomen, the distension being much greater in the loop itself than in the intestine above. Unless the condition is relieved, lymph soon mats together the base of the loop and renders it difficult to untwist. In severe cases the interference with the circulation increases and gangrene of the loop may set in, commencing at the seat of constriction; peritonitis occurs early. The upper part of the loop is usually rotated so that it passes in front of the lower, but in some cases exactly the opposite takes place. Occasionally the volvulus may be very complicated; the small intestine may also be involved, and may even be wound round the large.

The *symptoms* differ somewhat from those of internal strangulation, and a suspicion of the true state of affairs may often suggest itself before operation. The patients are usually older than those who are the subjects of internal strangulation, although this is a point upon which no great stress can be laid. There is often a previous history of constipation, one of the chief predisposing causes of the mischief being prolonged distension of the loop of the sigmoid, which leads to stretching of the meso-sigmoid by its weight. The onset is sudden, but the pain, although severe, is not usually quite so bad as in internal strangulation, whilst the colic is more marked, the vomiting is not so urgent, and the collapse is usually not so great. One of the chief symptoms which gives rise to a suspicion of this condition is early and very marked distension of the abdomen.

TREATMENT.—The essential points are to undo the twist and prevent its recurrence if possible; but this is frequently very difficult, partly because the torsion is often complicated and also because the parts at the root of the twist become glued together. At the same time, however, it is absolutely essential, and the first thing to be done is to bring the loop out of the abdomen, otherwise it is impossible to see the precise condition of affairs. Even when this is done, the enormous distension of the coil usually hides the seat of volvulus, and attempts to manipulate the bowel are apt to cause rupture of the peritoneal coat, at any rate. Therefore, as soon as the distended loop has been brought out of the abdomen, it should be packed around with abdominal cloths, a dish placed beneath

its most prominent portion, a small incision made into it, and the contents evacuated (see p. 343). It will then be possible to manipulate it easily. After the loop has been emptied, the small hole should be cleansed and sutured before proceeding further with the operation. It is seldom that the colon above is so distended as to interfere with the subsequent steps of the operation, but if so, it should be brought out over the side of the abdomen and its contents evacuated in turn ; it is, however, a difficult matter to get the descending colon well out of the abdomen, and in most cases the opening must be made in the transverse colon.

When the twisted loop has been emptied, it is carefully examined to see in what direction the twist is, whether from right to left or *vice versâ*,



A B

FIG. 129.—PAUL'S TUBE AS USED TO ESTABLISH A TEMPORARY FÆCAL FISTULA. The introduction of the purse-string suture is shown in *A* ; instead of occluding the lumen of the loop by means of the fingers of an assistant, as shown above, one or two pairs of intestinal clamp forceps or Lane's clamps may be used. When the suture is in place the bowel is opened, the tube is inserted and tied in, and the loop of bowel is fastened to the skin as is shown in *B*.

and whether the loop is twisted round itself or whether one coil of intestine is twisted round another. In order to untwist it, the whole mass should be grasped between the surgeon's two hands and rotated bodily in the opposite direction to that in which the volvulus has occurred. If the twist is recent, the lumen of the bowel is at once restored, and there is no great risk of recurrence. When, however, it has lasted for several hours, the tissues around the neck of the volvulus are much infiltrated with lymph, and not only is the unwinding very difficult and unsatisfactory, but the coil is apt to re-wind again as soon as the pressure is released ; in order to get it untwisted the adhesions should first be gradually separated by the finger. To prevent recurrence, it is a good plan to pass a large-sized thick india-rubber drainage tube through the anus and rectum well up into the sigmoid and leave it in position for at least

forty-eight hours. Another plan is to fix a Paul's tube into the opening in the bowel which was made to evacuate the contents of the loop and fasten it to the parietes, thus making a colostomy opening (see Fig. 129). It is also advisable to stitch the meso-sigmoid to the abdominal wall or to the iliac fascia. The stitches must not be introduced through the bowel wall as they might tear through and lead to perforation ; they must be passed through the outer layer of the meso-sigmoid without constricting the blood-vessels. If this does not suffice, the loop may be moored by the appendices epiploicæ.

Should it be impossible to untwist the volvulus, or should the mass be gangrenous, the outlook is exceedingly grave, for the surgeon has no alternative but to resect the entire mass—a procedure which is generally more severe than the patient can stand. To form an artificial anus in the loop does no good, because the affection is left untouched and the gangrene will proceed uninterruptedly. When, however, the patient cannot possibly stand the necessary resection, the best that can be done is to make an artificial anus both in the involved loop and in the colon above by the aid of Paul's tubes (*vide supra*). This, however, is very unlikely to succeed, and should only be done when it is impossible to do anything else.

CHAPTER XXIII.

INTUSSUSCEPTION: OBSTRUCTION AFTER LAPAROTOMY

ACUTE INTUSSUSCEPTION.

INTUSSUSCEPTION is a very common form of intestinal obstruction, and forms more than a third of the cases. It is by far the most common form of obstruction in children, and is almost the only one met with in infants. In it a portion of the bowel becomes invaginated into the gut below, so that the intestinal canal is doubled upon itself. It seems to be not so much a projection of a contracted portion of intestine into that below as what may be called a swallowing of the contracted upper part of the bowel by the part below. The usual opinion is that this occurs most frequently at the ileo-cæcal valve, and in nearly one half the cases the intussusception is formed by the lower end of the ileum passing into the cæcum, the apex of the invaginated portion being the ileo-cæcal valve. This form is called the *ileo-cæcal* intussusception, but in some cases classed in this group, the apex of the intussusception is not the ileo-cæcal valve itself, but an inch or two of the cæcum, and in reducing these cases the last thing to be undone is a dimple in the cæcum itself. The next most common form is the *enteric*, in which one part of the small intestine, generally the jejunum, passes into the part below. Much more rare are the *colic* intussusceptions, in which one portion of the large intestine is received into another. This is most common about the sigmoid flexure and the upper end of the rectum, and usually occurs in connection with growths of the intestine. The rarest form of all is the *ileo-colic*, in which the ileum passes through the ileo-cæcal valve and projects into the colon.

Intussusception is due to various *causes*. In infants the affection may be preceded by some intestinal disturbance, such as diarrhœa, and owing to irregular contraction of the bowel, a portion of the contracted intestine passes into the lumen of the bowel immediately below. Not infrequently,

however, the infant is in perfect health up to the moment of invagination of the bowel, and very often is quite a robust child. In young infants there is generally some abnormality of the bowel present, and in older children and in adults the invagination is not infrequently brought about by the presence of foreign bodies in the bowel or growths in its wall. In the latter case it is particularly the polypoid forms, which, hanging into the bowel, lead to irritation and irregular contraction, so that the polypus is dragged down and pulls the bowel after it; occasionally it occurs in connection with Henoch's purpura, in which there is an

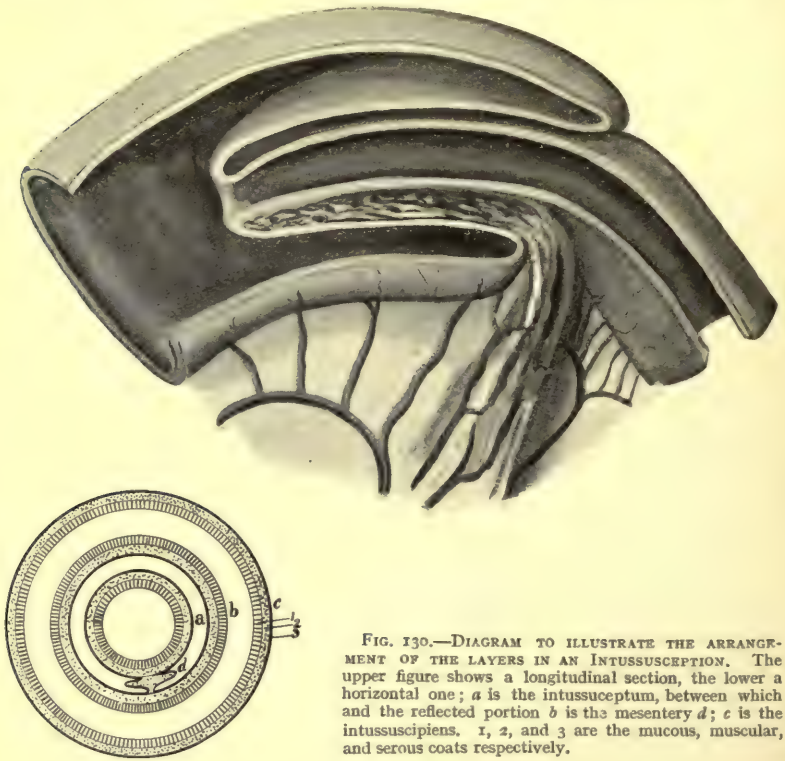


FIG. 130.—DIAGRAM TO ILLUSTRATE THE ARRANGEMENT OF THE LAYERS IN AN INTUSSUSCEPTION. The upper figure shows a longitudinal section, the lower a horizontal one; *a* is the intussuceptum, between which and the reflected portion *b* is the mesentery *d*; *c* is the intussuscipiens. 1, 2, and 3 are the mucous, muscular, and serous coats respectively.

extravasation of blood into the wall of the bowel. A Meckel's diverticulum, or the appendix may be invaginated and lead to the formation of an intussusception. Carcinomatous growths are sometimes the exciting cause of the condition in elderly people. The size of the intussusception may vary very greatly, and the apex of the intussusceptum may actually protrude from the anus.

Pathological changes.—An intussusception consists of three parts: the intussusceptum, or the part drawn in; the intussuscipiens, or the sheath or receiving layer; and the reflected portion, or the part of the intussuscipiens which is bent upon itself (see Fig. 130). Thus, counting

from without inwards, there are three complete thicknesses of the bowel wall concerned in an intussusception—namely, the outer wall of the intussuscipiens, the inner or reflected layer of the latter, and the intussusceptum. It is important to note that the apex of an intussusception is a constant point. The increase in length of the tumour occurs at the expense of the sheath, which becomes more and more invaginated; as the apex travels on, it causes reflection of an increasing portion of the sheath.

Two very important points arise in connection with the presence of the mesentery. As the intussusceptum travels along the bowel, the mesentery becomes more and more constricted as it passes over the neck of the intussuscipiens, and the circulation in the intussusceptum becomes interfered with; further, owing to the pull upon the mesentery, there is an alteration in the direction of the intestinal tube and increased obstruction at the apex of the intussusceptum. The vessels in the mesentery being constricted, the intussusceptum and the reflected layer become œdematous and swollen, and if the constriction at the neck of the intussuscipiens is tight, the circulation in the intussusceptum may be entirely arrested. The result is that hæmorrhage takes place into the intestinal wall and inflammation of the mucous membrane occurs; these two changes give rise to the chief symptoms of intussusception—namely, the passage of blood and mucus. When the constriction is very tight, the interference with the circulation may be so severe as to cause partial or complete gangrene of the intussusceptum. The time of onset of the gangrene varies; it may be present at the end of twenty-four hours, or several days may elapse before its occurrence; the tighter the constriction, the more early will gangrene occur.

Another effect of the presence of the mesentery is obstruction to the passage of intestinal contents through the intussusceptum. In the early stages, before much swelling or alteration in the direction of the canal occurs, the liquid contents may pass on. As the swelling becomes more intense, the obstruction becomes greater, and this is increased by the fact that, as the intussusceptum becomes longer, it curves towards the mesenteric border until finally its apex is more or less firmly pressed against the wall of the intussuscipiens and a mechanical blockage is added to that produced by the swelling. Further, the pull of the mesentery causes the opening in the apex of the intussusceptum to become changed from a round hole to an elongated slit which still further interferes with the passage of intestinal contents.

When obstruction is thoroughly established, no intestinal contents pass through the intussusception, although the patient's bowels may be acting frequently; all that is passed is a quantity of mucus and blood derived from the engorged vessels of the intussusceptum and the inflamed bowel in the vicinity. This swelling of the intussusceptum forms one of the chief obstacles to the reduction of the intussusception. The

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intussusceptum soon becomes so thick that it cannot be squeezed out of the intussuscipiens without considerable force, and attempts to reduce it in its swollen condition often lead to splitting of the peritoneal coat of the bowel and may indeed rupture all the coats.

Adhesive peritonitis also occurs between the opposed peritoneal coats of the intestine—that is to say, between the reflected layer of the intussuscipiens and the outer surface of the intussusceptum, provided that the latter is still alive. If, however, the intussusceptum is gangrenous, no peritoneal adhesions form between it and the ensheathing layer except at the neck of the intussuscipiens where the two layers of the intestine may become matted together. The occurrence of peritonitis at the neck of the tumour has a twofold result. While on the one hand it forms an obstacle to reduction, on the other hand it is Nature's protection to the patient, because, if firm peritoneal adhesions occur around the neck, he may live, even though the intussusceptum becomes gangrenous and separates. The continuity of the bowel may thus be restored without any communication having formed with the peritoneal cavity.

The *symptoms* of intussusception are briefly those of acute intestinal obstruction, to which are superadded others so distinctive that an intussusception can generally be diagnosed without difficulty. The onset is rapid and accompanied by collapse and vomiting and the other general symptoms of acute intestinal obstruction (see p. 330). The collapse, however, may pass off speedily and the child may apparently recover and remain well for a time. The most common special symptoms are *constant tenesmus*, which is especially marked when the intussusception is of the colic variety, or when an ileo-cæcal intussusception has reached the lower part of the large intestine ; there is a constant desire for the bowels to act, and this is not fruitless, as in other cases of intestinal obstruction, but is accompanied by *the passage of mucus tinged with blood* and sometimes with a certain amount of fæcal matter. In some cases, however, tenesmus may be entirely absent, and there may be no passage of blood or mucus, especially if the child is seen soon after the onset of the symptoms. A rectal examination should never be omitted ; on withdrawing the finger it should be examined for the presence of blood and mucus. It is a useful plan to wipe the finger on a piece of lint or cotton-wool ; small amounts of blood are then more easily seen. An *abdominal tumour* soon forms, which is sausage-shaped and is most commonly found in the right iliac or lumbar region ; it is not always easily made out, even when the patient is under an anæsthetic, because it may lie under the ribs and may be entirely concealed there. Usually, however, it can be felt under an anæsthetic, especially if a bimanual examination is made with the aid of a finger in the rectum. The tumour varies somewhat in consistence, and it can often be noted that it changes its position and alters its shape. A very important practical point is that the absence of an intussusception should not be assumed

because a tumour is not detected. This especially applies to infants in whom intussusception is the only common cause of intestinal obstruction in the absence of an external hernia.

In young children, a swelling of the intestine may be felt in cases of Henoch's purpura as the result of hæmorrhage into its wall, and it may be very difficult to diagnose between the two conditions; the possible presence of this disease should therefore be borne in mind; and it should not be forgotten that an intussusception may follow a hæmorrhage of this kind.

Results.—Acute intussusception, when not operated on, is very fatal in young children and usually causes death in three or four days. Occasionally, especially in older subjects, it may be followed by recovery which ensues as a result of gangrene of the intussusceptum accompanied by adhesion of the neck of the intussuscipiens to the intestine above; such cases are usually followed at a later date by annular constriction of the bowel and symptoms of chronic intestinal obstruction.

Spontaneous reduction of the intussusception is very rare, although it does occasionally occur. The period during which the intussusception can be easily reduced is usually very short, as a constriction of the mesenteric vessels of comparatively slight duration rapidly leads to so much œdematous swelling as to make reduction difficult. This to some extent depends upon the anatomical form present, and is most rapid in the ileo-colic form, in which the ileo-cæcal valve grips the small intestine extremely tightly and leads to rapid and complete strangulation.

TREATMENT.—The only form of treatment admissible is reduction of the intussusception immediately the diagnosis is made. The patient cannot be watched, because the surgeon is not justified in hoping for spontaneous recovery, and the sooner active steps are taken the better.

In the *non-operative treatment*—which, however, we do not recommend—an attempt is made to force back the intussusceptum from below by injecting air or fluids of various kinds into the bowel so as to distend it and exert pressure on the apex of the intussusceptum and so force it out of the intussuscipiens. This is occasionally successful, but most often it does not lead to complete reduction and the apex of the intussusceptum still remains unreduced and the trouble soon returns. Not only may precious time be lost in this way, but injury may be done to the bowel wall by over-distension. Although this plan may be of use in some cases as an aid to operation, it should not be employed alone if by any possibility operation can be performed.

The *operative measures* consist in opening the abdomen, exposing the tumour and squeezing the intussusceptum out of its sheath. To diminish the shock, rapidity of operating is essential, especially in young children,

in whom the whole operation in an uncomplicated case ought not to take more than fifteen to twenty minutes. Normal saline solution should be infused into the axillæ during the operation; in an infant four to six months old, two to six ounces of saline are sufficient.

The laparotomy wound should be made by preference through the right rectus. When the abdomen has been opened, the intestines should be packed away and the tumour brought into view. The swelling should first be examined *in situ* especially to see if there are any signs of gangrene at the neck—in which case no attempt must be made to reduce the tumour. The tumour should then be brought into view as much as possible, so that the surgeon can watch what happens when the intussusceptum is reduced, especially whether there is any splitting of the peritoneal and muscular coats; the tumour should not be reduced in the dark. The best method of reduction is to grasp the lower part of the swelling in the left hand so that it lies completely surrounded by the palm; then the apex of the intussusceptum is pushed up by a gentle squeezing movement, and as it goes it will unroll the intussuscipiens. This onward pressure should be very gentle and slow, so as to avoid rupture of the coats, while at the same time it should be fairly firm so as to lessen the œdema at the apex of the intussusceptum. In most cases it will be found that the greater part of the intussusception can be reduced readily in this way. It is dangerous to attempt to pull out the intussusceptum, for not only will the attempt fail in most cases, but also there will be a great risk of tearing the neck of the intussusceptum which has been constricted and which may be on the verge of gangrene. A point is usually eventually reached at which it is difficult to reduce the intussusceptum, not so much on account of adhesions as of the swelling at its apex. If a cautious continuation of the pressure reduces the intussusception, well and good; any split of the peritoneal coat that accompanies reduction can be stitched up with a fine Lembert suture, the bowel dropped back, and the abdomen closed. On the other hand, however, the attempt may not succeed, and, further, the intussusception may not only be irreducible, but also gangrenous. The further procedure will therefore depend partly on which of these conditions is present, and partly on the state of the patient.

When the tumour is irreducible but not gangrenous.—The ideal treatment is to excise the part affected and unite the divided portions of the intestine; this, however, is often inadvisable on account of the serious condition of the patient. To excise the whole of the affected portion—that is to say, to make one incision through the bowel above the neck of the tumour and another below the apex of the intussusceptum, to remove the entire intervening portion, and then restore the bowel either by end-to-end suture or by lateral anastomosis, is a severe measure in an infant.

Several procedures have been suggested, of which we may mention

that described by Mr. Barker—namely, local resection of the intussuscepted portion through an incision in the ensheathing layer.[1]

The tumour is reduced as far as possible and is then brought out of the abdomen, and intestinal clamps are applied above and below it. A continuous Lembert suture is made to unite the entering to the ensheathing layer all round the neck of the tumour. The intussuscipiens is then incised over the tumour and the intussusceptum pulled out through the opening. The forefinger of the left hand is now thrust up its lumen to serve as a guide for the stout transfixion stitches which are to unite all the coats firmly together. These are very quickly introduced

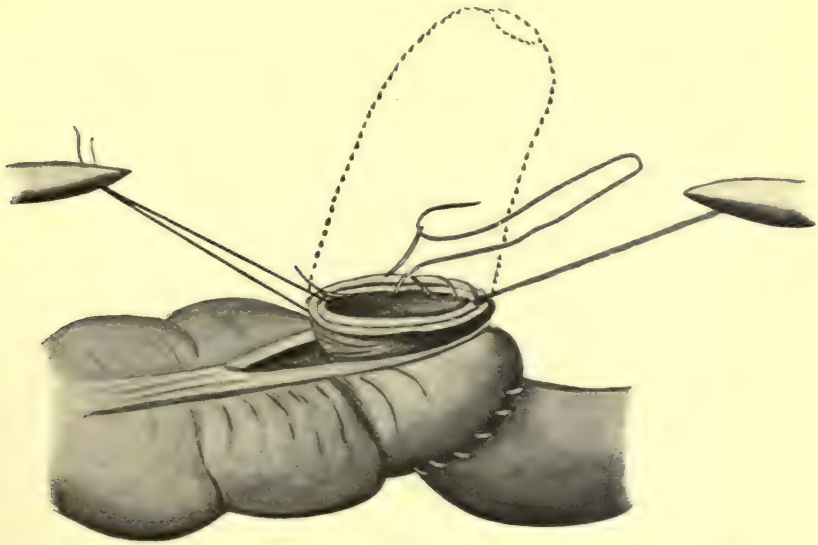

FIG. 131.—REMOVAL OF THE INTUSSUSCEPTUM BY BARKER'S METHOD. Two of the four transfixion sutures are shown held in forceps. The dotted line represents the portion of the intussusceptum and the reflected layer that is cut off. The suture is shown in position about the neck of the intussusceptum, and the cut edges of the intussusceptum and the reflected layers are being united by a through-and-through suture.

by thrusting a threaded nævus needle completely through the intussusceptum from side to side as near the neck as possible ; a second needle is passed in a similar manner, but at right angles to the first. Then the entire intussusceptum is cut off just below the level of the sutures (see Fig. 131). The loops of the threads as they pass across the lumen of the bowel are pulled out and divided, and thus four sutures, each of which traverse all the coats of the intussusceptum and the reflected layer of the sheath, are formed. These sutures are then tied and keep the two portions of bowel firmly in apposition. The vertical incision

[1] See *British Medical Journal*, 1892, vol. ii. p. 1226, and *Medico-Chirurgical Transactions*, vol. lxx. p. 335.

in the intussuscipiens is closed in the usual manner (see Fig. 132) and the clamps removed.

Another method which has been successfully adopted in some cases is simply to relieve the obstruction by a lateral anastomosis of the bowel above and below the obstruction. The obvious disadvantage of this method is that the intussusception is not dealt with and may become gangrenous and lead to fatal peritonitis. The advantages are rapidity of operation and the restoration of the intestinal canal, thus avoiding the necessity for any further operation.

When the tumour is gangrenous, the condition is very serious indeed. Here Barker's operation is inadmissible, and the best method is to excise

FIG. 132.—BARKER'S OPERATION FOR INTUSSUSCEPTION COMPLETED. The vertical incision in the intussuscipiens has been closed.

the portion of intestine containing the gangrenous intussusceptum, and either bring out the ends and insert Paul's tubes in each (see p. 343) or perform a lateral anastomosis, after invaginating the divided ends of the bowel. Unfortunately, the infant rarely recovers from either of these procedures.

There is another method which we have carried out successfully in one case, in which the patient was not in a condition to stand resection of the bowel; it is to bring out the loop of bowel above the obstruction and make an artificial anus, while at the same time the intussusceptum is invaginated a little farther and a continuous catgut suture is inserted through the sero-muscular coats at this newly formed neck. The object of the formation of an artificial anus is to remove one of the causes of the patient's death—namely, obstruction and absorption of fæcal material—and to give time for separation of the gangrenous intussusceptum without perforation at the neck. The artificial anus can be closed subsequently.

The object of increasing the intussusception and applying the continuous catgut suture is to avoid perforation at the neck of the intussusceptum when separation takes place; it brings about union between more healthy portions of bowel.

CHRONIC INTUSSUSCEPTION.

Occasionally an intussusception occurs comparatively slowly, and for various reasons—*e.g.*, excessive length of the mesentery or large size of the lumen of the bowel—the constriction of the intussuscepted portion is not as great as usual. These cases belong to the intermediate group between the acute and chronic forms of intestinal obstruction. The initial onset is acute, then the symptoms subside for a time, and, as more of the bowel is invaginated, the acute symptoms recur; the history of the illness may thus extend over many days. Such cases usually occur in older children or in adults. In the latter, perhaps the commonest exciting cause is the presence of either a benign villous tumour or a cylindrical epithelioma in the sigmoid flexure or at the ileo-cæcal valve. The weight of the tumour causes a downward protrusion of the mucous membrane into the lumen of the bowel, and thus the growth becomes, so to speak, a foreign body which the bowel tries to expel, and it forms the apex of the intussusceptum. Owing partly to the wide lumen of the large bowel, partly to the absence of a complete peritoneal investment and possibly partly to thickening of the bowel wall above the original tumour, there is a remarkable absence of bad symptoms. The vascular circulation is not hampered to any serious extent, the passage of the intestinal contents being alone interfered with, but the obstruction may not be complete. As in all other cases of chronic intestinal obstruction, however, the symptoms may become acute at any time, and complete obstruction may supervene

The *diagnosis* is extremely difficult, and in many instances the condition is not made out until the abdomen has been opened. Sometimes the symptoms are acute at first and then become chronic, but in the majority of cases they come on quite slowly, and the surgeon has little to guide him beyond the ordinary symptoms of incomplete obstruction. . Should the trouble have been acute at the onset, the symptoms of acute intussusception may have subsided and left signs of chronic obstruction; here there may be a doubt as to whether the symptoms are due to a continuance of the intussusception or to adhesions left by it. The presence of a tumour can be made out in a considerable proportion of the cases, but this may be difficult to distinguish from other abdominal swellings, particularly those found in tuberculous peritonitis. As a rule there is no continued bleeding from the intussusceptum such as gives rise to the characteristic stools in the acute form. Occasionally the diagnosis is made by feeling the apex of the intussusceptum in

the rectum, or even by seeing it protruding from the anus; rectal examination should never be omitted.

TREATMENT.—**Palliative.**—If it is decided to postpone operation, either because the symptoms are not urgent and the surgeon is not sure of their cause, or because the patient wishes to wait before an exploration is undertaken, *careful dieting* is very important. Only fluids—peptonised milk, meat-juice, etc.—should be given by the mouth, and this may be reinforced by rectal feeding, except in cases in which there is marked tenesmus. Simple enemata may be employed in order to promote the action of the bowels, but no strong purgatives should be administered; small doses of *salines* may, however, be given. If there is much pain, *opium* or opium and belladonna may be used. But as soon as it has been decided that the case is one of chronic intussusception, operative measures should be undertaken.

Operative.—As a rule there is no firm adhesion between the intussusceptum and the intussuscipiens in these cases, and much of the invagination may be undone by pressure. The apex of the intussusception, however, may not come out, and either Barker's operation or resection of bowel, including the irreducible portion of the intussusceptum, must be undertaken, followed by lateral anastomosis or end-to-end union of the divided portions of the bowel. If the affected part is the sigmoid and a large portion has to be excised owing to the presence of a malignant growth, it may be better not to attempt to bring the ends together, as the tension on the stitches may be so great that they may cut out, and fatal peritonitis result. Under such circumstances the lower end may be sewn up and a colostomy established at the upper end, or both ends may be sewn up and an anastomosis made between the lower end of the ileum or the transverse colon and the lower segment.

OBSTRUCTION DUE TO ADHESIONS AFTER LAPAROTOMY.

Intestinal obstruction occurring after abdominal operations, particularly in the pelvis, is an accident that must always be borne in mind. These cases are intermediate between the acute and chronic forms as regards the acuteness and severity of the symptoms, but really belong to the acute form as regards their pathology, and they constitute a true intermediate group between the two. The course of events in this form of obstruction is as follows: for the first day or two after the original operation the patient apparently goes on well, but then begins to suffer from flatulence, distension, sickness, and frequent colicky pains. At first the bowels may act and flatus may be passed, especially after the employment of enemata; but the obstruction rapidly increases and ultimately becomes complete, and the patient will die unless relief is obtained. The condition is usually at its worst about five or six days

after the operation, but complete obstruction may be delayed somewhat longer.

The explanation of this set of phenomena is that a coil of intestine becomes adherent to the raw surface left in the abdomen, and becomes kinked and fixed with lymph. The result is that the bowel above becomes distended with flatus, and thus the kink is increased until ultimately the obstruction is complete.

TREATMENT.—Unless the kink is relieved the patient may die of exhaustion from the pain and vomiting, or of poisoning by the decomposing contents of the intestine above the obstruction.

Prophylactic.—The frequency of this accident in the early days of intra-abdominal operations, such as ovariotomy and hysterectomy, has led to various improvements in the technique in order to avoid it ; these consist essentially in the formation of peritoneal flaps which are stitched over the raw surfaces, so that the latter shall be covered by peritoneum. Another important point is to see that no blood is left in the peritoneal cavity.

Palliative.—The occurrence of distension, colicky pains, and vomiting after laparotomy should always engage the surgeon's most serious attention, and although it may not be necessary to re-open the abdomen on the first appearance of the symptoms, this must be done unhesitatingly and without delay if they continue or get worse. It may happen that the kinking is not great, that the adhesion is slight, and may stretch, and that the condition may be recovered from ; it is well to operate, however, unless improvement is evident in two or three days.

Immediately the symptoms occur, *enemata* containing turpentine must be administered in order to promote active peristalsis, and so possibly to detach the bowel ; a saline purge should also be given. No food should be given by the mouth, as it increases the abdominal distension, but rectal feeding may be employed ; salol in ten-grain doses may be used with the object of diminishing decomposition of the intestinal contents. The position of the patient should be arranged so as to produce a certain amount of dragging on the attached coil ; thus, when the accident occurs after a pelvic operation, the buttocks should be raised and the patient placed in a modified Trendelenburg position. Opium should be avoided, but belladonna may be given, as it soothes pain and promotes peristalsis ; it may be usefully combined with strychnine.

It is important to remember that the adhesive material is soft during the first few days, and that the bowel can then be easily detached, whereas if several days are allowed to elapse, organisation of the adhesions occurs and renders detachment of the bowel difficult and increases the risk of tearing its wall. Hence, however reluctant the surgeon may be to reopen an abdominal incision if it can possibly be avoided, he must not delay the operation too long.

Operative.—Should the symptoms increase in intensity or the obstruction become absolute, the incision already made should be reopened, and the patient is placed in such a position that the intestines will fall away from the site of adhesion—*e.g.* in the Trendelenburg position after pelvic operations. The edges of the wound should be widely retracted, because it is most important to see exactly what one is doing, especially in order to avoid tearing the softened bowel wall while detaching it. The intestines are carefully kept out of the way with abdominal cloths which are also packed round the operation area in case the bowel wall is damaged. As a rule, separation of the adherent bowel is easily effected if the abdomen is opened within the first few days after the original operation, but it must be done carefully and methodically; above all, the gut must not be pulled upon, for it is not only adherent but softened by the inflammatory changes, and will tear readily. The best way of effecting the separation is to press the stump to which the bowel is adherent away from the latter with a swab, and to insinuate the finger through the lymph gradually. It is much safer to work with the finger alone or with abdominal pads than with any form of blunt dissector or metal instrument. The bowel wall is so soft and friable that instruments are apt to perforate it however carefully they are handled. A perforation of this nature, moreover, is not easy to suture, owing to the softness and want of pliability of the muscular wall.

When the coil has been detached, it should be inspected to see if it has been damaged and if a permanent kink has been formed. When the operation has been done quite early, this will not be the case, and the bowel can be replaced safely. When, however, a longer period has elapsed, a kink may be present, which is not rectified by detachment of the bowel, and resection of the affected part of the bowel may then be necessary; the condition of the patient, however, may negative the performance of so severe an operation and the surgeon may have to bring the loop of intestine into the wound and insert a Paul's tube (see p. 343), leaving the repair of the enterostomy opening to a subsequent date. Before closing the abdominal wound all possible steps must be taken to avoid a recurrence of the obstruction, and this is very likely to happen if a raw surface covered with lymph is left. If possible, therefore, the peritoneum on each side of the stump should be detached and brought over the raw surface, as ought to have been done in the first instance. The areas in question may be smeared with sterilised vaseline or pure paraffin in order to promote movement of one portion upon the other. The abdomen is then closed, and the after-treatment is the same as for acute obstruction (see p. 344).

CHAPTER XXIV.

CHRONIC INTESTINAL OBSTRUCTION.

CHRONIC intestinal obstruction differs from the acute form both in its pathology and its symptoms. This is not merely due to the fact that the obstruction in the one case comes on rapidly, while in the other it occurs slowly ; it is because the pathological conditions are different.

We may group the cases of chronic intestinal obstruction as follows :—

1. Incomplete obstruction. In these cases there is a gradual narrowing of the lumen of the bowel, but not yet complete closure.

2. Complete obstruction, due to complete closure of the canal and consequent arrest of the passage of the intestinal contents.

The narrowing of the lumen of the bowel which leads to chronic intestinal obstruction may arise from the following conditions : causes outside the gut, such as the pressure of tumours or constriction by adhesions between adjacent portions of the bowel ; various forms of stricture resulting from ulceration of the mucous membrane or from the growth of tumours in the intestinal wall ; obstruction by something in the interior of the bowel filling up its lumen more or less completely—for example, a polypoid growth, an accumulation of fæces, or a foreign body.

These conditions may give rise to either of the forms of obstruction mentioned above—namely, the essentially chronic form due to the narrowing of the bowel and difficulty in the passage of the contents, and the more acute phase when the blockage is complete ; even in the latter condition, however, both the symptoms and the pathology differ widely from those met with in acute intestinal obstruction.

3. This typical chronic intestinal obstruction may be complicated by the occurrence of the true acute form. In cancer of the sigmoid flexure, for example, the weight of the tumour and the accumulated fæcal material above may give rise to a volvulus of the sigmoid, so that a true acute obstruction supervenes. Again, it is not uncommon for an intussusception to occur in connection with a tumour of the bowel, which is impeding the passage of the intestinal contents, and in that case the

tumour forms the apex of the intussusception. Chronic obstruction may also be complicated by the independent occurrence of true acute obstruction—for example, when the chronic condition is due to adhesions compressing or kinking the bowel and an acute internal strangulation takes place beneath some of these adhesions. These cases do not require further consideration here ; when they occur they add immensely to the diagnostic difficulties, but their treatment is essentially that of acute intestinal obstruction accompanied if possible, either at the same time or later, by that suitable for the cause of the chronic obstruction.

Symptoms.—The various conditions enumerated above have this feature in common, that they interfere to a greater or less degree with the passage of the intestinal contents ; the lumen of the bowel becomes steadily narrower and the contents pass on with increasing difficulty. The chief troubles of which the patient complains in this stage of incomplete obstruction are constipation, colicky pains which are increased after food, and general loss of appetite ; in fact, he frequently diagnoses his own condition as one of chronic indigestion. The constipation frequently alternates with diarrhœa, the material passed being foul and containing mucus. The explanation of the latter point is that enteritis is set up as the result of the accumulation of fæces above the stricture, and when the block is removed, diarrhœa sets in. There may also be tenderness over the seat of the obstruction. The abdomen is generally moderately distended, and peristaltic waves may be seen through the abdominal wall if the patient is spare. The intensity of these early symptoms varies greatly ; the patient may suffer so severely that he seeks advice comparatively early, or the symptoms may attract little attention, and advice is only sought when the obstruction reaches an advanced stage, and even then it is often difficult to get a history pointing to a previous incomplete obstruction. If asked, the patient frequently states that he was in his usual health, or that he had perhaps been a little more troubled with indigestion than usual, but otherwise the difficulty with the bowels has occurred quite acutely. A close inquiry into what is meant by indigestion, however, generally elicits the symptoms of interference with the passage of the intestinal contents. If the condition remains unrelieved, attacks which at first resemble the onset of complete obstruction may occur. The pain increases in severity, the constipation becomes almost absolute, and there may be vomiting. As the result of enemata or the administration of cathartics these symptoms may pass away, only to recur after a longer or shorter interval.

After a period, varying greatly in different cases and with different causes of obstruction, complete occlusion occurs ; this generally arises from some mechanical cause, such as plugging of the narrow orifice by scybala or by a foreign body, or inflammation of the mucous membrane of the intestine above the stricture, leading to complete closure of the lumen. The symptoms formerly complained of increase in severity,

the patient becomes absolutely constipated and realises that there is a difficulty in the onward passage of the intestinal contents. He gradually becomes distended from the accumulation of gas, he begins to suffer from acute griping pains, and finally vomiting sets in; but it is usually at quite a late period that the vomited material becomes what is called fæcal. If the condition is unrelieved, the patient usually dies from the increasing weakness produced by the continued vomiting, from the mechanical strain thrown upon the heart and lungs by the distension, from poisoning by the intestinal contents or from ulceration above the obstruction, sometimes followed by perforation and peritonitis. Sometimes, however, the symptoms subside, the bowels are relieved, and the patient recovers temporarily; but before long a similar attack occurs.

The symptoms of chronic obstruction are fairly typical, but it is by no means always easy to come to a definite conclusion as to its cause or its situation. Nevertheless, it is most important to determine both these points as accurately and as quickly as possible. At any moment complete intestinal obstruction may occur and the patient's condition then becomes rapidly very grave. An operation under such circumstances entails the most serious risks to the patient's life; a search for the seat of obstruction is most difficult and dangerous in a distended abdomen, and the surgeon has to content himself with a palliative operation such as colotomy, when in the absence of obstruction a radical operation such as excision of a growth might have been undertaken with a good prospect of success.

The nature of the trouble may be indicated by special symptoms. For example, a cancer of the large intestine may give rise to hæmorrhage from the bowel, to pressure on nerves, or to cachexia. Examination of the abdomen either from the surface or bimanually through the rectum or vagina, and also under an anæsthetic if necessary, may reveal the presence of a tumour, while an ulcer or stricture may be seen by the sigmoidoscope.

The seat of the obstruction may also be indicated in various ways. For example, the shape of the abdomen is of importance; a generalised globular distension points to an obstruction in the small intestine; a flattened abdomen, distended especially in the flanks, suggests obstruction in the large intestine generally about the sigmoid flexure; while irregular and localised distensions generally occur above the stricture. The presence of an area of unusual tympanites or dullness should also be looked for, the coil of intestine immediately above the obstruction being frequently distended with gas and consequently tympanitic, or it may be full of solid or liquid material and give a dull note on percussion.

In obstruction of the large intestine valuable information can sometimes be obtained by making the patient swallow fourteen ounces of bread and milk, into which 2-4 ounces of oxychloride of bismuth has

been stirred, and then taking X-ray photographs of the abdomen at intervals of a few hours, until the bismuth has reached the rectum. If there is a stricture or kink, the bismuth accumulates above it and the degree of contraction may be indicated by the length of time it takes for the material to pass through. Similar investigations should also be made by injecting a bismuth emulsion up the rectum, and then examining the abdomen by the screen or taking a radiogram; this will show whether the bismuth has passed freely upwards or has been arrested at any point. As a rule it is easy to force the bismuth up as high as the middle of the transverse colon when there is no stricture.

Lastly an exploratory operation may be performed before complete obstruction has set in so as to determine the existence and the situation of the obstruction and to deal with it at an early stage while the condition may still be remediable.

CHRONIC OBSTRUCTION FROM CAUSES OUTSIDE THE BOWEL.

Assuming that these various investigations have been made, we shall proceed to consider the treatment of the different conditions which may be present according as the obstruction is incomplete or complete.

CHRONIC OBSTRUCTION CAUSED BY TUMOURS.

It is not uncommon for the intestine to be compressed by a tumour external to it—for example, the sigmoid flexure or rectum may be pressed upon by uterine or ovarian tumours to such an extent that intestinal obstruction results.

TREATMENT.—The obvious treatment is to remove the obstructing cause, but this is not always possible, either because the tumour is too firmly fixed or because the patient's condition will not allow of it. If the tumour is a simple ovarian or uterine growth, its removal may present no difficulties; if it is malignant, it may not merely press upon the intestine, but may involve its wall, and be irremovable. When the tumour is inoperable, or the patient is so ill from obstruction that removal is out of the question, it is best to establish an artificial anus, and then, if removal of the tumour is possible, to proceed to excise it, and close the artificial anus when the patient has recovered from the effects of the obstruction.

CHRONIC OBSTRUCTION CAUSED BY ADHESIONS.

The other extrinsic cause of chronic intestinal obstruction is adhesions following peritonitis—usually tuberculous. The intestinal coils become matted together in this affection, or the omentum becomes thickened and

adherent to them and the inflammatory material contracts as the disease passes off and may constrict the bowel and give rise to an incomplete obstruction. In addition, there is often great shrinking of the mesentery leading to kinking of the intestine, or there may be adhesion of the bowel to its own mesentery, the gut being, as it were, rolled up in it, so that the anti-mesenteric border is the nearest point to the root of the mesentery (see Fig. 124); or the greater part, or the whole of the small intestines may become matted together, and a serious obstacle to the onward passage of the intestinal contents produced.

Another not uncommon cause of these peritonitic adhesions is appendicitis. Not only are coils of intestine frequently matted together, but the lower end of the ileum, or more rarely the ascending or even the pelvic colon, may be compressed by adhesions to such an extent as to diminish the calibre of the bowel very seriously; in other cases the transverse colon becomes adherent to the ascending colon forming an acute kink at the hepatic flexure. Similar adhesions also occur in connection with other forms of local peritonitis, such as salpingitis or pericmetritis. Another very frequent seat of peritonitic adhesions is in the neighbourhood of the liver as the result of gall-stones and cholecystitis, or of the stomach as the result of gastric ulcer (see p. 293); in these cases the large intestine and the stomach are chiefly affected. Sometimes these adhesions follow injuries; in these cases hæmorrhage has probably occurred and the organising blood-clot gives rise to the adhesions. Another example of obstruction from adhesions may be met with after the relief of a strangulated hernia, in which the lymph thrown out at the line of strangulation may organise into a permanent constriction; it is, however, more probable that this constriction is due in most instances to ulceration of the mucous membrane and contraction of the granulation tissue, and not merely to external adhesions. Lastly, adhesions of this nature may form after abdominal operations.

In these cases there may be actual constriction of the bowel by the adhesions, or merely kinking of the gut by the pull of the contracting inflammatory tissue; most usually constriction and kinking are combined. The result is a long period of incomplete obstruction with attacks of more complete obstruction usually after eating indigestible materials. The patient often suffers much colicky pain, the abdomen becomes distended and the hypertrophied coils of intestine may be seen moving beneath the abdominal wall, while the patient emaciates, often to an extreme degree when the small intestine is affected.

TREATMENT.—The treatment is often very unsatisfactory, although brilliant results may be obtained when the adhesions are limited. In a good many instances the diagnosis is comparatively easy, the previous history of the case, the age of the patient, and other symptoms, pointing pretty clearly to the nature of the trouble. Operative treatment is not very satisfactory, and a thorough trial should be given to other methods

in the first instance. The reason for delay in operating is that it is often very difficult to separate the adhesions, and even when this has been done fresh ones almost invariably form; while, on the other hand, it is remarkable how adhesions tend to become absorbed and disappear as time goes on.

(*a*) **Palliative.**—The non-operative treatment consists essentially in *careful dieting*; the chief point is to see that the food is easily digestible and not likely to give rise to solid lumps, which might block the narrowed intestine. Meat should be either very tender or finely minced, and fibrous vegetables, raw salads, nuts, and suchlike indigestible food, should be strictly avoided. It is generally necessary to employ some *laxative* to secure a regular action of the bowels, and for this purpose one of the various mineral saline waters may be taken in the morning in small doses. Many patients prefer the vegetable cathartics, such as one of the preparations of senna; freshly prepared senna-tea made by infusing six to twenty senna-pods for twenty-four hours in cold water, is a very valuable form, which can be taken for long periods without any unpleasant consequences; others derive great benefit from some bland lubricant, such as pure paraffin (℥ss. twice or thrice daily). *Massage* and *electricity* may be applied to the abdomen with the object of moving on the contents of the intestine and gradually loosening and stretching the adhesions; neither must be employed, however, if active peritonitis is present.

(*b*) **Operative.**—When the symptoms are severe and continue in spite of treatment, laparotomy must be performed and the adhesions divided. The abdominal cavity is opened in the middle line unless there is a very distinct indication to the contrary. The position of the incision relative to the umbilicus will vary according to the indications; if the adhesions are situated in the upper part of the abdomen—in connection with the gall-bladder, for example—the opening will be above the umbilicus; if the symptoms point to adhesions in Douglas's pouch it will be as low down as possible. When there is no definite indication, the opening should be below the umbilicus, but in most cases it will have to be extended upwards. Great care must be taken in opening the abdomen, because the intestines may be adherent to the abdominal wall; before dividing the peritoneum, therefore, it is necessary to make sure of this point, and if adhesions are present, the opening in the peritoneum should be made above or below the adherent area. After the abdomen has been opened, the procedure depends essentially upon the conditions found, and as these vary enormously, it is impossible to do more than indicate the chief lines of treatment.

If the adhesions are few and limited to one portion of the intestine, cautious division of them will often suffice. We have seen this procedure successful in a good many cases: in one, where a narrow line of adhesions, the result of an old appendicitis, had constricted the lower end of the ileum,

the bowel resumed its natural calibre after the bands were divided, and the intestinal contents passed on at once although the patient had previously been almost moribund from what was practically acute intestinal obstruction.

When the condition is due to traction on a loop of the bowel, producing a kink, the latter may straighten out when the adhesions have been divided, and in that case the lumen of the bowel is at once restored. These are, however, exceptionally favourable cases.

After a contracting band has been divided, fibrous tissue may be found along the groove of the kink producing a permanent constriction. An attempt should first be made to relieve this by carefully notching it with a tenotome ; if this is not followed by expansion of the bowel, and if the patient's condition allows, the affected part should be excised and the continuity of the bowel restored by lateral anastomosis. If, however, his condition is too critical for this, the groove may be invaginated by a row of Lembert sutures and a lateral anastomosis performed between the portions of bowel immediately above and below the kink, as small a portion as possible being short-circuited.

In cases of *adhesion of the intestine to the parietal peritoneum,* it may be possible to detach it ; but if the union is very firm at any spot, it will be best to leave the adhesion, but divide the peritoneum all around so as to free the bowel ; the adhesion is often so firm that any attempt to separate the bowel from it will lead to rupture. The parietal peritoneum may then be further separated and the raw surface on the parietes, if small, covered over by stitching together the cut edges of the peritoneum.

When a large mass of the bowel is matted together attempts may be made to separate these adhesions by notching them with a knife and separating the adherent coils gently with the finger, great care being taken not to rupture the intestine. In detaching these adhesions, the muscular coat of the bowel may be torn without injuring the mucous membrane ; such injuries should be looked out for, and if they occur should be sutured with fine catgut before proceeding farther. This separation leaves a large raw surface on the intestine, the abdominal wall, or any other structure to which adhesion has taken place, and the probability of recurrence or of the formation of fresh adhesions is very great. With the view of avoiding this, the raw surface may be rubbed over with sterilised vaseline or pure paraffin, or covered with a detached omental graft. It is well also to change the patient's position frequently during the after-treatment so as to prevent the raw surfaces from coming in contact and adhering again ; for example, after adhesion of the intestine to the gall-bladder, omentum may be brought over the raw surface and the patient kept sitting up in bed, so as to carry away the raw intestine from the denuded gall-bladder. Fresh adhesions may form elsewhere, but they may not cause any particular discomfort. When the omentum is healthy, the

raw surfaces may be covered by portions of this structure, which may be either completely detached, or (where large surfaces have to be covered) left with sufficient attachment to retain their vascular supply ; omentum adheres readily to the raw area, and this procedure may diminish the chance of reproduction of the old adhesions.

The most difficult cases are those in which there is widespread matting of the bowels together. Sometimes the bulk of the small intestines form a matted mass drawn up towards the upper part of the abdomen, and the bowel is so involved that attempts to free it are out of the question ; the surgeon is then face to face with a very serious problem. Two alternatives have been proposed—namely, to excise the whole mass of adherent intestines and unite the divided ends, or to do a lateral anastomosis between healthy intestine above and below the obstructed mass. Both of these procedures are very grave, and may be quite out of the question. In very severe cases almost the whole of the small intestine is involved, and to cut it out or to shut it off from the intestinal circuit by an anastomosis might lead to the patient's death from starvation. On the other hand, when the mass, although so matted that it cannot be separated, is quite small, and involves not more than a few feet of small intestine, the best plan is to excise it. Excision is much better than simple short-circuiting, because after the latter procedure, loops of intestine are left in which intestinal contents accumulate and undergo decomposition, whereas excision and subsequent union restore the normal passage of the bowel at once. The choice between excision with union of the gut, and short-circuiting by lateral anastomosis without excision will be determined mainly by the condition of the patient and the probability of his surviving the more prolonged operation of resection. It must, however, be admitted that when such extensive adhesions exist, it is seldom that either plan can be adopted. When the matting is very extensive, it may be possible to ascertain where the kinks are most acute, and to anastomose the adjacent coils *in situ*. Fortunately, however, most of these cases are tuberculous, and after opening the abdomen great improvement often follows ; further, when the surgeon is certain that the obstruction is due simply to matting of the bowel, he will have less hesitation in administering drastic purgatives.

When the obstruction resulting from adhesions has become complete and the operation is done for the acute condition the outlook is very grave indeed. It may be that separation of some narrow contracting band over the bowel will liberate it sufficiently to permit the onward passage of the intestinal contents. It may be that there is a limited kink which separation of adhesions will free, or excision of the kinked portion with re-union of the bowel may meet the requirements of the case. But, when these extensive adhesions exist, it is generally difficult to do any good by operating. A lateral anastomosis or a temporary enterostomy above the obstruction will probably afford the patient the best chance.

CHRONIC OBSTRUCTION FROM CHANGES IN THE BOWEL WALL.

The most common forms of chronic obstruction come under this heading and the stenosis may be congenital, or due to stricture following ulceration of the mucous membrane, or to malignant disease. Stenosis of malignant origin is usually due to a primary growth occurring in the mucous and sub-mucous tissue and subsequently infiltrating the rest of the wall and leading to ulceration.

CHRONIC OBSTRUCTION FROM SIMPLE STRICTURE.

Congenital strictures and malformations of the bowel may occur in different parts of the intestinal tract, but are most frequent in the rectum (see Chap. XXXIV.). The degree of stenosis met with elsewhere may vary from a complete solution of continuity between two segments of the bowel to an incomplete diaphragmatic septum. Congenital strictures may occur in the duodenum, and are generally situated just above the entrance of the common bile-duct. Another situation of congenital stricture of the intestinal canal is the ileum, usually in association with Meckel's diverticulum. Congenital strictures of the colon are very rare.

These congenital conditions very seldom come under surgical treatment, for the reason that when they are serious the symptoms become manifest immediately after birth and at a time when no effectual operative procedure can be borne by the infant. Should they be partial and become evident later on, the condition will only be very slight and the treatment will be analogous to that of stricture originating after birth.

Among the congenital malformations of the bowel which come under notice are *fæcal fistulæ*, occurring usually in connection with the omphalo-mesenteric duct; here there is practically no possibility of remedying matters because the intestine below is so very narrow and badly developed that it would not carry on its functions even if resection and end-to-end union were done.

Strictures due to non-malignant ulceration may originate in various ways; they occur most commonly in connection with tuberculous disease of the intestine. Tuberculous ulceration of the intestine in connection with tuberculous peritonitis is dealt with in Chap. XXVIII., but we may make a few remarks about it here.

Tuberculous ulcers are most frequently met with in the lower part of the ileum, and the ulcers may be either single or multiple; the multiplicity of tuberculous ulcers should be borne in mind when operation for this form of stricture is called for, because the relief of one stricture may not cure the symptoms. The ulcer is often extensive and elongated, with

its long axis transverse to that of the bowel; it may encircle the bowel more or less completely and lead to an annular constriction. The ulceration may pass deeply into the sub-mucous and muscular coats, in which case peritonitis occurs outside, and the contraction of the exudation increases the narrowing still further. The affection is often accompanied by tuberculous peritonitis (see Chap. XXVIII.). *Typhoid ulcers* and *acute duodenal ulcers* rarely give rise to stricture. Very severe stricture may follow the spontaneous cure of an *intussusception* by sloughing.

Dysenteric ulcers commonly lead to a certain amount of stricture, but as they occur in the large intestine, they seldom produce so much narrowing as to cause prominent symptoms of obstruction; when they do so, they are generally situated in the sigmoid flexure or towards the upper part of the rectum. *Ulcerative colitis* is a very fatal disease, although it may also occasionally be the cause of constriction. *Syphilitic ulceration*, leading to stricture, is very rare, except at the lower part of the rectum; this is dealt with in Chap. XXXVII.

CHRONIC OBSTRUCTION DUE TO MALIGNANT STRICTURE.

New growths causing stricture of the bowel are practically always malignant and are adeno-carcinomata. In the great majority of cases the growth is primary in the bowel itself, and springs from the Lieberkühnian follicles; it soon infiltrates the sub-mucous tissue, and finally penetrates to the muscular and peritoneal coats. The wall of the bowel, however, may sometimes be involved secondarily—chiefly from direct continuity—by malignant disease of other parts, such as the uterus, prostate, ovaries, or stomach. Malignant growths are by far the most common cause of stricture of the large intestine, and, after forty or fifty years of age are almost the only ones. In the small intestine non-malignant strictures seem to be more common than malignant ones.

Carcinoma of the bowel forms a hard, raised nodule projecting from the mucous surface of the intestine. This nodule soon ulcerates and the disease spreads around the bowel until a characteristic constriction is produced—namely, a sort of diaphragm of growth across the lumen presenting towards the centre a ragged ulcerated aperture, which is often very narrow. The amount of growth present in proportion to the constriction produced is very variable; sometimes the stricture is extremely tight like a ring round the bowel, while the amount of growth is very small indeed; sometimes there may be extensive growth, but no great blocking of the canal. The disease affects the glands in the neighbourhood—in this instance, in the mesentery—and leads to secondary growths, especially in the liver. It is an important point that the disease in the glands and in the liver usually grows more slowly than the primary disease in the bowel, and when the latter has been removed, a considerable time may elapse before the secondary growths cause death. Sometimes

the disease spreads to the peritoneal coat, and then infection of the peritoneum occurs and cancerous nodules form all over it and give rise to a cancerous peritonitis accompanied by effusion of fluid into the peritoneal cavity. The intestine above the stricture becomes greatly dilated, and—in the early stages, at any rate—the walls are much hypertrophied; in the large intestine the longitudinal bands are greatly thickened and may be mistaken for prolongations of the disease. The mucous membrane above the stricture becomes inflamed and may ulcerate, and the bowel may even give way in that situation.

The situation of these strictures varies very much; they occur most frequently towards the lower end of the sigmoid flexure or at the commencement of the rectum. Other favourite seats are the cæcum and the flexures of the colon.

Complete obstruction will ultimately result, unless the patient dies of some intercurrent affection; the closure of the lumen of the bowel may be brought about in various ways. Most commonly, perhaps, it results from blocking of the narrow opening by some foreign body, such as hardened fæces, or pieces of undigested food; in other cases the obstruction is due to inflammatory swelling of the mucous membrane above the stricture. Occasionally the tumour may cause a volvulus or an acute intussusception, but in these cases the symptoms are typical of acute intestinal obstruction.

The *symptoms* are indistinguishable in most respects from those already detailed (see p. 362); but in a malignant stricture, especially when it is low down, there is often the occasional passage of blood-stained material, and a large quantity of mucus due to colitis above the stricture. The presence of a tumour may or may not be detected; this depends to a great extent on the situation of the disease and on the amount of growth present, and also on the degree of abdominal distension. When there is quite a narrow constriction no tumour can be made out from the outside, and cases have occurred in which a surgeon has passed his finger along the whole colon from the cæcum down to the sigmoid flexure after the abdomen had been opened and has failed to detect a stricture which was found *post mortem* in the transverse colon.

TREATMENT OF SIMPLE AND MALIGNANT STRICTURES.

This varies according as the obstruction is incomplete or complete.

1. When the obstruction is incomplete.—The ideal treatment is to remove the stricture (whether it be simple or malignant) while the patient is in a comparatively good state of health, and then to restore the continuity of the intestine by anastomosis. If the existence of a tumour can be made out there must be no delay in opening the abdomen either to remove the disease if that is possible, or, if not, to perform some operation, such as a short-circuit or an enterostomy, to

relieve the symptoms; the earlier the diagnosis is made the greater will be the chance of removing a growth.

Resection of a stricture.—The *incision* will vary with the situation of the disease. If a tumour is felt in the region of the cæcum, the ascending or the descending colon, or the sigmoid flexure, an incision over the seat of the disease will no doubt give most convenient access; on the other hand, when the situation of the disease is unknown or can only be guessed at from the symptoms, the abdomen should be opened in the middle line. Except in the case of the ascending and descending colon, most tumours of the intestine can be removed through a median incision.

With regard to the *excision of the stricture* there is little to add to what has been said on p. 324. End-to-end anastomosis is best performed by simple suture, but most surgeons prefer to close the ends of the bowel and perform a lateral anastomosis; this is especially the case in the large intestine. In removing a tumour from the small intestine a wedge must be taken out of the mesentery, and this should enclose all the enlarged glands, if possible; if this is not done, the glands and fat must be removed, taking care not to interfere with the blood-supply of the bowel.

It is an open question whether the surgeon should excise a local growth in the intestine, even though it is readily removable, when it is accompanied by a glandular infection that negatives any hope of eradicating the disease. In our opinion this should be done, for the following reasons: In the first place, the patient, if not actually suffering from complete obstruction, must inevitably do so before long, and will need an operation for the relief of that, notwithstanding the existence of secondary growths; therefore an operation which restores the lumen of the canal while the patient's condition is good is the best thing that can be done, quite apart from the question of whether the disease is eradicated or not. In the second place, the secondary growths in the glands and the liver usually progress much more slowly than does the disease in the bowel, and, apart from the comfort and prolongation of life afforded by relief of the obstruction, life may be further prolonged by removing the rapidly growing intestinal disease.

The details of the operations will vary with the seat of the disease. In the case of a simple stricture of the small intestine or a freely movable malignant growth there is little difficulty. As there is often a marked difference in the calibre of the bowel above and below the obstruction lateral anastomosis is, as a rule, the most satisfactory method of uniting the divided ends.

The chief difficulty in excising malignant tumours of the bowel occurs when they affect the more fixed parts of the intestine, parts not completely surrounded by peritoneum, or parts such as the hepatic and splenic flexures of the colon, which are difficult to get at. In the case of

the ascending and descending colon, it may be impossible to approximate the divided ends, and under such circumstances the surgeon may either insert a Paul's tube into the upper end and sew up the lower, or both the divided ends may be closed and a lateral anastomosis effected with some more movable part of the bowel, such as the ileum to the transverse colon in cancer of the ascending colon, or the ileum or the transverse colon to the sigmoid flexure in cancer of the descending colon. We may describe excision of the cæcum as an example of the method of removing a tumour of the intestine.

Excision of the cæcum.—When the growth involves the cæcum and the ileo-cæcal valve, and it is found on detaching the reflection of the peritoneum from the cæcum to the abdominal wall that the tumour has not spread outside the wall of the bowel and can be removed, the line of resection will go on the one hand through the lower end of the ileum and on the other through the ascending or transverse colon, the ileo-cæcal valve being removed together with the cæcum (see Fig. 133); at least six inches of the bowel on each side of the growth should be removed on account of the tendency of the disease to spread along the submucous lymphatics for a considerable distance. The exact seat of division of the bowel is also determined by the distribution of the blood-vessels and the extent to which it is necessary to remove meso-colon in order to extirpate the glands; unless the former point is attended to, part of the bowel left behind may not have proper blood-supply. This is especially important in excising portions of the transverse colon. In the case of cancer of the cæcum, the extent of large intestine removed is usually that supplied by the ileo-colic artery.

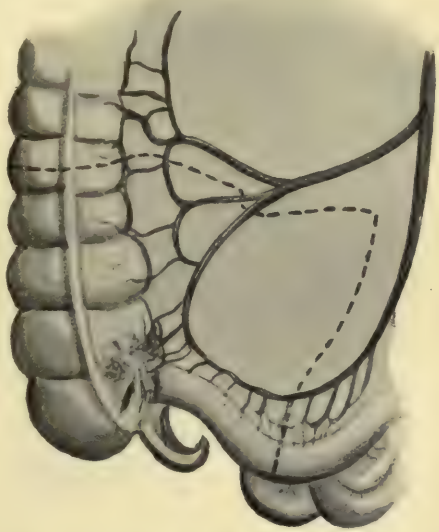

FIG. 133.—LINES OF SECTION FOR EXCISION OF THE CÆCUM. By making the incisions along the dotted lines the blood-supply of the remainder of the bowel is preserved intact.

The peritoneum is divided as it is reflected from the outer side of the cæcum to the abdominal wall, and the bowel is separated and brought out of the wound. The distribution of the glands in the meso-colon is studied and the amount of the meso-colon which will require removal is

decided on. If enlarged glands run high up in the lumbar region they may be removed along with their surrounding fat, but the greatest care must be taken not to tear veins in the portion of meso-colon left behind, otherwise it will be necessary to take away an unduly large piece of bowel. Both the ileum and the colon are next clamped in two places above and below the stricture, the situation of the clamps being determined by the considerations already mentioned, and the bowel is then divided on each side between the clamps, the cut ends covered over with gauze pads and the tumour removed; some surgeons divide the bowel with the actual cautery in order to disinfect the cut surfaces. The open ends of both portions of bowel should be invaginated and sewn up in the ordinary manner, and then if it is possible, a lateral anastomosis should be performed between the ileum and the transverse colon (see Fig. 134). If the condition of the patient is very bad, it may be best to introduce a small Paul's tube into the end of the ileum, and close the end of the large intestine, leaving the lateral anastomosis to a later period. This, however, should be avoided, if it is possible to complete the operation at the time. Care must be taken to see that the peristaltic wave runs in the same direction in the ileum and the colon.

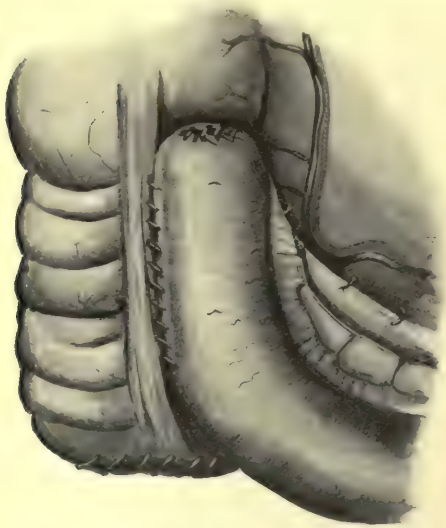

FIG. 134.—LATERAL ANASTOMOSIS AFTER EXCISION OF THE CÆCUM. The gap in the meso-cæcum has been closed by sutures.

Many strictures of the intestine—more especially the malignant ones—are so situated or are so extensive that excision is out of the question; and under these circumstances two alternative methods remain—namely: anastomosis of the bowel above with that below the stricture, so as to enable the intestinal contents to pass without going through the strictured portion—an operation spoken of as 'short-circuiting'—or the formation of an artificial anus above the stricture.

Short-circuiting. — It is clear that an intestinal anastomosis is far superior to an artificial anus, and should be done whenever it is possible. The chief objection to it, and one that must be attended to in operating, is the tendency of the opening to contract, and, as in the case of gastro-jejunostomy, this is most marked when the intestine above the stricture is much dilated (see p. 263). To avoid this it is important to make what

may appear at the time to be an unduly free communication between the two portions of the bowel; for this reason the anastomosis is better done by simple suture than by any form of apparatus, and this plan should always be adopted, except when the patient is so ill that the few additional minutes may unduly increase the risk of the operation. These cases are not common, however, and in experienced hands the time saved by the employment of Murphy's button or Mayo Robson's bobbins is not considerable. The openings should be made on the convex borders of the bowel, and it is important to see that the gut is so applied that the peristaltic wave runs in the same direction in each loop. If the wave travels in one direction in the upper portion of the bowel and in the opposite in the lower, there will be difficulty in the passage of the fæces; from the

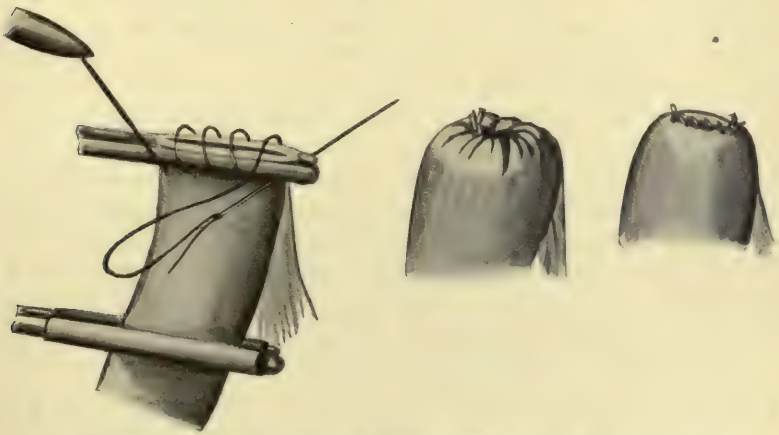

FIG. 135.—METHOD OF RAPIDLY OCCLUDING THE END OF THE BOWEL IN LATERAL ANASTOMOSIS. A running through-and-through suture is inserted before the clamp is removed. This stitch is then pulled tight and tied and thus puckers up the end of the bowel. This suture is eventually buried by a continuous Lembert suture.

proximal loop of the gut they will be driven into the upper portion of the distal loop, and when that empties itself they are apt to be driven back again into the proximal loop. In the small intestine this is not a matter of very great importance as the contents are fluid and readily run past the opening; but in the large intestine, where the contents are more solid, much trouble may be caused. Hence in joining large and small intestine, the small intestine should be applied alongside the large in such a way that the peristaltic wave runs the same way in both.

A second point of importance in performing a short-circuit operation is not to shut too much of the bowel out of the circulation lest fæces accumulate in the loop (especially in the large intestine), become dry, and cause trouble; they dilate the loop, cause pain by pressure on the stricture, and lead to inflammation and even ulceration of the mucous membrane. Hence it is well to leave as short a space between the

opening and the stricture as possible. Another reason for this is the possibility of partial or even complete internal strangulation through the loop thus formed. Further, in bringing the two portions of the intestine together there must be no stretching of the intestine and the two portions should lie easily together without kinking. In the case of a cancerous stricture, where the anastomosis must not be made too near the growth, it is best, in order to avoid a long loop, to divide the bowel above the loop, sew up both ends, and then unite the proximal portion with the distal at some distance below the growth.

The actual steps of the short-circuit operation are the same as those described for gastro-jejunostomy and for lateral anastomosis of the intestine (see pp. 265, 324).

Artificial anus.—An artificial anus should only be made when an intestinal anastomosis is impossible owing to the situation or extent of the disease. In the small intestine, an artificial anus must never be made except when nothing else can be done; even at a considerable risk to the patient a short-circuit operation should be performed if it is impossible to excise the stricture. An artificial anus in the small intestine, if high up, produces profound malnutrition, and, moreover, the intestinal contents are extremely irritating and give rise to an eczematous condition of the skin of the abdomen which is most distressing to the patient. When the skin becomes much inflamed the following prescription is of value:—

℞ Bismuthi subnit. }
Zinci oxidi . } . . āā ʒss.
Ol. eucalypt. . . . ℥xx.
Ol. ricini . . . . ad ʒij.
Misce.

This is rubbed over the skin around the opening at each dressing. When the surgeon is forced to make an intestinal fistula, the disadvantages may be to some extent minimised by employing the method described on p. 308.

2. When the obstruction is complete.—The foregoing remarks refer to incomplete intestinal obstruction in which the patient's condition is good and there is no urgency. Unfortunately, the surgeon is more frequently called to these cases when the obstruction has become complete and the patient's condition is therefore bad. Although physicians—who generally see these cases first—are becoming more alive to the advantage of early surgical treatment, many are still apt to go on treating them in the vain hope that the obstruction may be due to fæcal accumulation, and the patient is often almost moribund before a surgeon is called in.

In complete obstruction, the diagnosis of the seat of the obstruction, as well as of its nature, assumes the highest importance. In incomplete cases, even although the seat of obstruction may not be accurately

determined, the abdomen is not markedly distended and the patient's condition is pretty good and therefore it does not add materially to the risk to search carefully for the seat of the trouble. In cases of complete obstruction, on the contrary, the patient is not only unfit to stand a prolonged operation, but the abdomen is much distended and manipulations are correspondingly more difficult and more dangerous. The immediate problem in the latter cases is not so much to rid the patient of his disease as to save his life, and, as he is dying of obstruction, the chief problem is to relieve that condition.

Cases in which the obstruction has lasted some time and the patient's condition is bad and will not permit of a prolonged operation.—In this condition a prolonged search among the distended coils for the seat of obstruction is out of the question, and an excision or a short-circuit operation would be dangerous in the highest degree. Practically, the only thing to be thought of is the formation of *an artificial anus*, and the only question is where such an opening should be formed.

The seat of the opening must be decided by the symptoms and the *history of the case*, and the determination of this point is often a matter of the greatest difficulty. The *shape of the abdomen* may help the decision. Distension mainly about the umbilicus, and not in the flanks, points rather to dilatation of the small intestine, and therefore to a stricture, either in the small intestine itself, or in the commencement of the large. On the other hand, an abdomen that is much distended in the flanks, but flatter than in the former instance, points to an obstruction lower down in the large intestine. Irregularity in the distension may indicate at what portion of the large intestine the obstruction exists; thus great distension on the right side with comparatively little on the left, implies an obstruction higher up than the sigmoid flexure, especially if the left iliac fossa is not much affected. On the other hand, the distended colon may be traced down to the left iliac fossa, in which case the stricture is probably in the sigmoid. The fact that the disease is situated somewhere in the sigmoid flexure in the great majority of cases should also be borne in mind. Indications will also be given by the *severity of the symptoms*. The previous history of the patient, and especially the occurrence of griping pains which stop at a certain point, though not to be depended on, may also give some idea as to the seat of the obstruction when taken in conjunction with the other symptoms. If *X-rays* are available and time permits, some definite information may be obtained by injecting a bismuth emulsion up the rectum, and determining the point where it stops by the X-ray screen; but this is very rarely possible. The sigmoidoscope may also be of assistance.

Functionally, the most suitable place to open the bowel is in the sigmoid flexure, and in certain cases, when there are indications that the stricture is situated at the upper part of the rectum, the ordinary inguinal colostomy incision may be made; if, however, the sigmoid flexure is found

empty, a fresh incision must be made over the cæcum. Hence when the seat of stricture is uncertain, and the patient is *in extremis*, it is safer to perform a right-sided colostomy at once rather than run the risk of having to do a second operation. Even here the opening may still be on the distal side of the stricture. We have known a case in which the ascending colon was opened without relief to the symptoms, and, *post mortem*, the stricture was found at the ileo-cæcal valve. Hence, when the ascending colon has been exposed, the condition of the cæcum and ileo-cæcal valve must be examined especially when the ascending colon is not distended.

Colostomy on the right side.—The ascending colon may be reached either by an operation behind the peritoneum, or the incision may be made further forward and the intestine exposed through the peritoneal cavity. The latter operation is much to be preferred as it allows the surgeon to make sure that he is opening a distended portion of the bowel, and he can also pass his finger down along the colon and investigate the state of the cæcum and the ileo-cæcal valve. If the bowel here is above the seat of stricture, the artificial opening can be made quite satisfactorily. The chief drawback to a right-sided inguinal colostomy is the difficulty of securing an efficient spur, but this is not a matter of great importance, as a right-sided colostomy is often only a temporary measure in these cases, and therefore the less definite the spur the better for the subsequent restoration of the channel. The incision is made obliquely downwards and forwards with its centre a little more than an inch above the crest of the ilium and about two inches behind the anterior superior spine, the muscle fibres being partly divided, but chiefly separated. The large intestine will usually present at once on opening the peritoneum, and its condition is examined and it is brought into the wound, the peritoneum on the outer side being detached so as to free it sufficiently. A large Paul's or Collier's tube is inserted into the bowel (see p. 381), which is then sutured to the skin in the usual manner. If a spur is wanted, it can be formed by passing a silk stitch or glass or ivory rods through the meso-colon in the same manner as in left inguinal colostomy (see p. 380).

The chief objections to right-sided colostomy are that the contents of the ascending colon sometimes irritate the skin a great deal, and that a long piece of gut may intervene between the opening and the disease, in which fæces and gas may accumulate and cause a good deal of trouble. For these reasons a right-sided colostomy should only be regarded as a temporary expedient, and when the patient recovers from the obstruction the possibility of obtaining a more suitable opening, of excising the stricture, or of making an anastomosis, will have to be considered. Unless there is some distinct contra-indication, or unless the nature and seat of the obstruction have already been determined, the proper treatment is to open the abdomen in the middle line at a later date, search for the obstruction, and deal with it according to the principles already laid down

for chronic obstruction (see p. 372). If it is possible to excise the stricture, if an anastomosis can be made, or if a permanent left inguinal colostomy is eventually established, it is usually comparatively easy to close the opening on the right side, as the condition is really one of a fæcal fistula and not a true artificial anus.

Left inguinal colostomy.—If the surgeon comes to the conclusion that the disease is in the lower part of the sigmoid flexure, he is warranted in performing a left inguinal colostomy, even though the patient's condition be very grave. The oblique operation, a little higher up than is usual for cancer of the rectum, should be done so that the upper part of the sigmoid flexure can be reached, but the abdomen should be opened as in the ordinary operation (*vide infra*). If the portion of the sigmoid that presents in the wound is distended, it is certain that the bowel has been reached above the stricture, and, before proceeding farther, it is well to ascertain quickly the exact condition of the stricture, with the view to excision either immediately or at a later period. It sometimes happens that, on opening the abdomen to perform a colostomy, the tumour is found to be so movable that it can be brought out of the wound at once, and this should be done if it is possible. Sometimes it may be necessary to divide the meso-colon in order to free the tumour, but this adds little to the gravity of the operation. Under such circumstances, the question of immediate excision of the bowel, followed by an anastomosis of the two ends, will arise; but in the severe cases of which we are speaking, the patient is really not fit to stand this. The simplest plan is to bring the loop containing the tumour outside the abdomen, clamp the intestine above and below, cut the tumour away, and insert a Paul's tube (see p. 343) into each end of the bowel. The patient thus gets rid of the tumour and has an artificial anus formed, which may be closed later should he recover. In the majority of cases, however, the tumour is too fixed to allow of this, and left inguinal colostomy should be done, and should be followed immediately by the insertion of a Paul's or Collier's tube.

The ordinary oblique operation is performed as follows: An oblique incision, with its centre on the line from the anterior superior spine to the umbilicus, is made about an inch and a half internal to the anterior superior spine of the ilium. The external oblique tendon is split in the direction of the incision and it is well also to nick it slightly transversely on each side in order to avoid subsequent constriction of the bowel. The internal oblique and transversalis muscles are now separated at the upper part of the wound in the direction of their fibres, the transversalis fascia is divided, the sub-peritoneal fat torn through, and the peritoneum opened. The distended sigmoid, which generally presents, is pulled as far out of the wound as it will conveniently come, and the finger is slipped downwards along it and the tumour examined. If there are any scybalous masses in the bowel these should be manipulated into the loop before this is fixed to the abdominal wall. To fix the loop in position, and at the

same time to form a suitable spur, we employ one of the following methods, according to the necessities of the case. If the patient's condition is fair and the abdominal parietes not very fat, so that the bowel comes well out of the wound, we put in a mattress suture in the following manner. The skin is dissected back for a little distance, and a stout silk thread is passed through the rest of the abdominal wall near the upper end of the incision, then through the meso-sigmoid, and finally through the corresponding part of the abdominal wall on the opposite side. The needle, still threaded, is withdrawn and then made to traverse the several structures in a similar manner at the lower part of the wound (see Fig. 136).

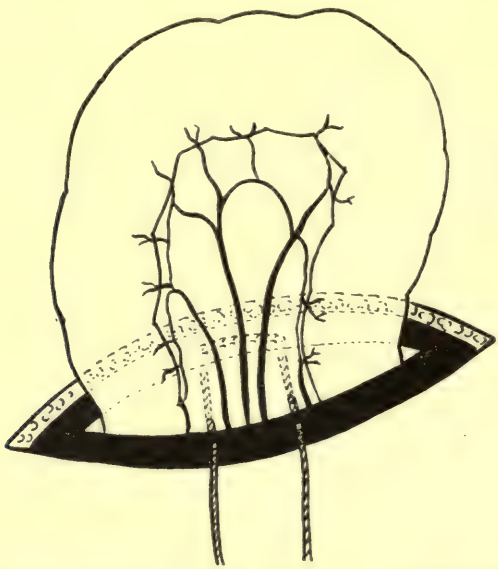

FIG. 136.—THE RETAINING SUTURE IN COLOSTOMY. The deep black line shows the musculo-peritoneal wall of the abdomen through which—and the meso-colon —the suture passes. Above this are the skin and fat.

When this suture is tied, the abdominal muscles are pressed against the sides of the bowel, and the suture passing behind the latter prevents it from slipping into the abdomen and at the same time helps to form a spur. Catgut sutures are inserted between the skin and the sero-muscular coat of the bowel. Some surgeons prefer to pass a rod of glass or ivory through the mesentery with its ends resting on the skin instead of employing the stitch which has been just described. This method is specially of value when the patient's condition is critical and rapidity of operating essential. One or two supports may be employed according to the necessities of the case; if the latter number, they should be about an inch apart. With an abdominal wound of suitable size, these pegs hold the bowel immovably in position and no stitches are required. We have lately

been in the habit of using specially designed metal pegs for this purpose which pass through the skin, the abdominal wall, and the meso-colon, and are mechanically bolted into position and hold the bowel immovably. With these the entire operation from first to last is a matter of a few minutes only (see Fig. 137). It is sometimes a good plan, before proceeding to the next stage of the operation to pass a loose ligature through the meso-colon, entering close to the bowel at the upper end of the loop, passing right across to the other side, and then going through the meso-colon close to the lower end of the loop in the reverse direction. This is not tied at the time, but left loose so that when the time comes for cutting off the superfluous portion of the bowel, it can be tightened and the circulation in the loop is controlled while the redundant tissue is cut away (see Fig. 138). A Paul's tube is then inserted in the ordinary way after any scybala have been squeezed out, or Collier's apparatus may be used.

Collier's apparatus.—This consists of the following parts (see Figs. 139, 140): *A* is a thin-walled india-rubber tube of the kind used with the ordinary Paul's tube. *B* is a cylinder of glass provided with a flange at its upper end over which the thin-walled tube (*A*) fits. To the lower end of the glass cylinder a short tube of moderately thick red rubber (*C*) is fitted. *D* is a special needle made in the form of two spirals, the upper of which is small enough to fit within the glass cylinder. There is a short connecting piece between the two spirals.

The apparatus is used as follows: The point of the spiral needle is pushed through the wall of the colon and the needle passed into the bowel with a corkscrew motion until the upper spiral and the connecting piece are all that is left outside the bowel. The red-rubber tube (*C*) is turned back over the end of the glass cylinder to form a sort of cuff, the glass being allowed to project for a fraction of an inch. The smaller spiral is then introduced into the glass cylinder, and by pressing on the opposite side of the bowel the whole of the spiral needle is held in close apposition to the cylinder. The projecting edge of the rubber tube which has been turned up is now turned down so as to embrace the lower and larger part of the spiral needle, the bowel wall being caught between the two.

The apparatus is thus firmly fastened to the colon, the lumen of the cylinder and that of the bowel being separated by the wall of the colon which forms a diaphragm between them. This diaphragm is now cut across crucially by a knife introduced through the open end of the cylinder and the thin rubber tube rapidly placed in position. In this method all risk of soiling the wound with fæces is avoided. The tube usually sloughs out in three or four days, but by that time the adhesion of the intestine to the sides of the wound is satisfactory if care is taken not to handle it. In about ten days the intestine should be cut off nearly flush with the skin, so as to leave two openings, one above and one below. In cutting off the projecting bowel a good deal of blood may be lost, and it is with the view of avoiding this that the loose stitch referred to above

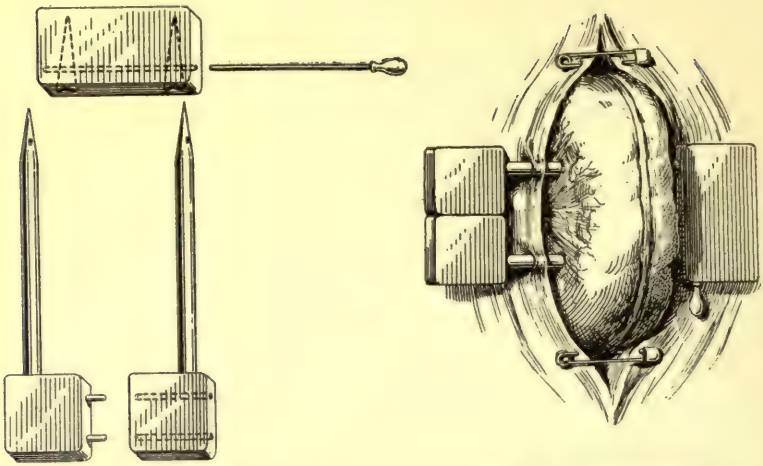

FIG. 137.—PINS FOR EXPEDITING THE OPERATION OF COLOSTOMY. Each pin—which is of tempered steel with a sharp point—is thrust through the skin and muscles on one side of the wound, then through the meso-colon, and finally made to traverse the constituents of the abdominal wall in the reverse order on the opposite side. The pins are bolted together, and the bowel can then neither advance nor recede. If two safety pins be passed through the lips of the wound and the muscular coat of the bowel as shown above, no stitches at all are necessary, and the operation can be done very rapidly. The manner in which the pins are bolted together is also shown.

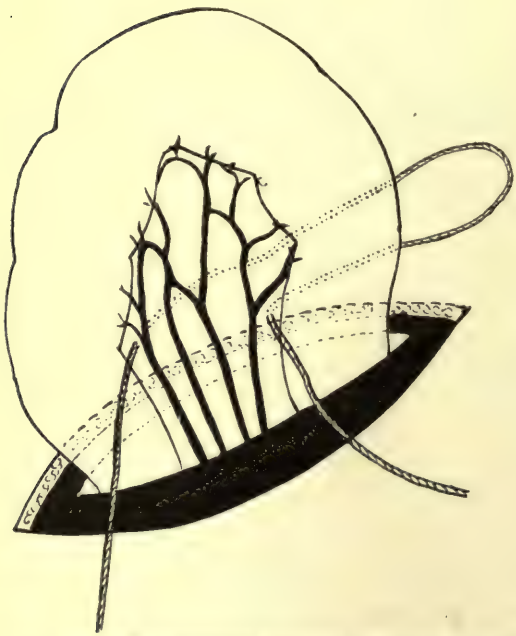

FIG. 138.—THE HÆMOSTATIC SUTURE IN COLOSTOMY. It will be seen from the diagram how the suture—the ends of which are knotted together and left long at the time of operation—will command almost the entire circulation in the loop of bowel when it is firmly tied as a preliminary to resection of the loop.

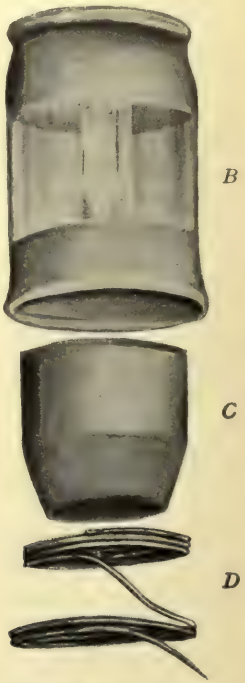

FIG. 139.—COLLIER'S APPARATUS FOR ESTABLISHING AN ARTIFICIAL ANUS. The description is given in the text. The thin rubber tube *A* is seen in the following figure.

is inserted. If this is employed, it must be borne in mind that if the second operation is performed too soon after the first, the act of tightening the ligature may detach the soft adhesions and leave a communication with the peritoneal cavity. After ten days, however, the adhesions are firm enough to resist this.

In performing colostomy for cancer of the rectum, a good many surgeons are abandoning the oblique incision for a more central one

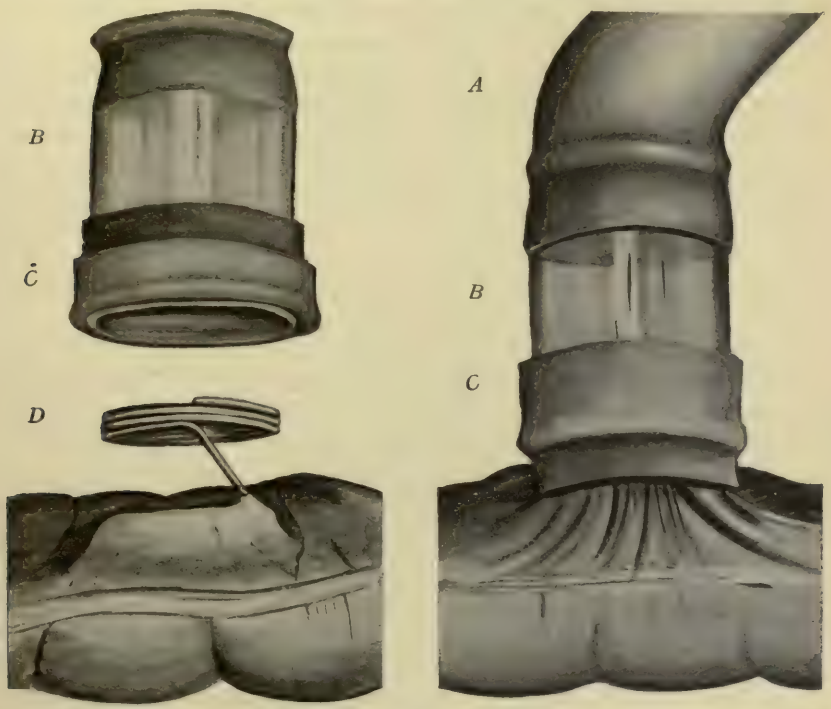

FIG. 140.—COLLIER'S APPARATUS IN USE. In the left-hand figure the needle *D* has been inserted into the lumen of the bowel. The india-rubber sleeve *C* is turned back and the glass tube *B* is about to be placed over the upper spiral of the needle. In the right-hand figure this has been done, the india-rubber sleeve *C* turned down so as to grip the lower spiral of the needle through the bowel wall and the thin rubber tube *A* has been attached to the opposite end of the glass tube *B*—after an incision has been made into the bowel—so as to convey away the intestinal contents.

through the left rectus muscle; but this is not very suitable when actual obstruction is present, as it may be necessary to get at the upper part of the sigmoid flexure or the descending colon, and for that purpose a fresh lateral incision would be required, while with the oblique method it is only necessary to extend the incision upwards and backwards.

Here, as in the right-sided colostomy, the primary object of the operation is to save life, but, when the obstruction has passed off, it may be thought advisable to attempt to remove the disease or to make an

anastomosis. The possibility of this may have been ascertained at the first operation. Should it be evident at the time of the original laparotomy that resection will be feasible later on, it is well only to draw enough of the sigmoid into the abdominal incision to allow the colostomy tube to be inserted. It is not even necessary to make a complete spur as the second operation will be done as soon as the effects of the obstruction are recovered from, and a small lateral opening into the bowel is much easier to close than a complete transverse division. It is also advisable to make the artificial anus well above the growth so as to give plenty of room for the subsequent resection and anastomosis.

In these cases the upper part of the bowel may be paralysed and unable to discharge its contents properly, and it may be necessary to evacuate it artificially (see p. 341). It is for this reason also, apart from the length of time required, that a short-circuiting operation is inadvisable in these cases, and if it is done it is well also to open the bowel higher up and evacuate its contents.

CASES IN WHICH THE PATIENT'S CONDITION IS GOOD AND THE DISTENSION IS NOT GREAT.

In these cases a more prolonged operation is possible and therefore a median laparotomy wound should be made in order to permit of due examination of the abdomen. The incision should be a little to one side of the middle line and should run from the umbilicus downwards for about four inches; it may be enlarged as may be required. The obstruction should be searched for in a methodical manner. In the first place the hand is passed over to the cæcum and its condition ascertained: if it is dilated the obstruction will be in the large intestine; if collapsed, it is in the small bowel. The condition of the appendix should also be ascertained. If the cæcum is dilated, the hand should next be passed over to the left side, and the condition of the sigmoid flexure similarly ascertained; this is the commonest situation of a malignant stricture. If the sigmoid is collapsed, the obstruction must be somewhere between it and the cæcum, and it will be advisable to extend the incision above the umbilicus so as to obtain good access. The ascending colon is then examined from the cæcum up to the hepatic flexure, then the transverse colon, and finally the descending colon; in this way the stricture will be identified with the least possible waste of time.

Should the cæcum not be found dilated, it will be necessary to examine the coils of the small intestine, and this is most satisfactorily done by beginning at the cæcum, hooking up the ileo-cæcal valve, and passing the small intestine through the fingers from below upwards; as each coil is done with, it is packed into the abdomen and kept in place by abdominal cloths.

When the obstruction is found, it is, if possible, brought into view

outside the abdomen ; if this is not possible, the surgeon should ascertain by careful palpation whether it is better to enlarge the existing incision or to make a fresh one in order to examine it more accurately ; this should not be done unless it seems possible to excise the tumour. The question of excising the tumour will be decided not only by anatomical considerations but also by the condition of the patient ; when obstruction has set in it is often inadvisable to proceed to such a severe operation as excision. If it is found that the tumour could be removed, but that the patient would probably succumb if the operation were done immediately, a short-circuit may be established if the situation of the growth and the condition of the bowel and of the patient allow of it, and the tumour can be excised later. If, on the other hand, removal of the disease is out of the question, a short-circuit operation should be done, if possible, as it leaves the patient without the disability of an artificial anus ; if this is not possible, a permanent colostomy must be established ; in the small intestine short-circuiting is the only possible procedure. Short-circuiting in no way interferes with subsequent excision of the stricture—in fact, it renders that procedure easier. In the cases which we are now considering the bowel is still able to empty its contents, and therefore there is not the same objection to short-circuiting as in the cases in which complete obstruction has existed for a considerable time.

OBSTRUCTION FROM CAUSES IN THE INTERIOR OF THE BOWEL.

FOREIGN BODIES may be introduced into the alimentary canal, intentionally or unintentionally ; the most frequent subjects of this form of obstruction are lunatics, and those who swallow objects for the purpose of gaining a livelihood. The various substances that have been found are too numerous to mention. As a rule the dangers attaching to foreign bodies are chiefly from their liability to perforate the intestine rather than from actual obstruction, and this especially applies to those furnished with sharp points or edges. Foreign bodies usually become impacted in the narrower parts of the bowel, such as the ileo-cæcal valve.

ENTEROLITHS are usually found in the rectum ; they may reach an enormous size and may be very hard ; they are also met with in the cæcum. Their nuclei may be composed of portions of food, such as the shells of nuts or cherry-stones, and, in addition, they generally contain salts of lime and magnesia.

GALL-STONES.—Intestinal obstruction by gall-stones, although rare, is well known. A gall-stone that can pass into the bowel through the common duct can hardly be large enough to cause intestinal obstruction, and it is probable that those sufficiently large to do this find their

way by ulceration from the gall-bladder into the duodenum. These stones do not occlude the intestine by reason of their large size. What usually happens is that spasm of the intestine occurs below the stone and the latter lies on the top of this contraction and completes the closure of the intestinal lumen. After death the stone is often found lying loose in the bowel. The two principal situations in which obstruction from this cause occurs are in the duodenum or at the ileo-cæcal valve.

These foreign bodies give rise to a form of obstruction which is often more or less acute, with such symptoms as griping pains in the abdomen, tenderness, and perhaps sickness. The foreign body gives rise to inflammation of the part of the bowel in which it lies, and dilatation of the intestine occurs above as in other forms of obstruction. A correct diagnosis is seldom made, although sometimes a gall-stone is recognised by the symptoms, the previous occurrence of bad attacks of biliary colic and the presence of a tender swelling. In some cases the following sequence of symptoms has led to the diagnosis—namely, intense pain in the gall-bladder region, violent vomiting, disappearance of the pain from the region of the gall-bladder, and its reappearance after a few hours in the umbilical region somewhat less severe than before and accompanied by less marked vomiting, with incomplete constipation.

POLYPI.—Intestinal polypi may give rise to incomplete obstruction, but they very rarely cause complete occlusion. They are commonly adenomata, though sometimes they may be fibromata, fibro-myomata, lipomata, or cysts. They usually have a narrow pedicle of mucous and sub-mucous tissue. They give rise to bleeding and excessive secretion of mucus, and may be mistaken for malignant tumours; they are not infrequently multiple.

Treatment.—Of foreign bodies.—When the foreign body is impacted in the small intestine it should be removed through a median laparotomy wound. When the abdomen has been opened, the seat of the impaction should be sought for in the same manner as in cases of chronic obstruction from other causes, and the portion of the intestine involved pulled out of the wound, clamped above and below, opened, and the foreign body removed. It is well to open the intestine above and not immediately over the foreign body, as the wall of the bowel in the latter situation is usually inflamed, and sutures may not hold satisfactorily in it; it is generally easy to extract the foreign body from above either entire or piecemeal. The incision in the bowel is closed in the usual manner.

Of polypi.—The loop of bowel affected is brought out of the wound, clamped above and below, and its wall divided over the tumour; after the pedicle has been transfixed by a double ligature the growth is snipped off. The closure of the intestine is carried out in the usual way (see p. 222). When the tumour is sessile it may be necessary to excise the portion of the intestinal wall.

Of cysts.—These are extremely rare causes of obstruction and they

are usually so intimately incorporated with the bowel wall that excision of the affected loop of the intestine is the only radical treatment. As a palliative measure the outer wall of the cyst may be clipped away so as to allow the portion which is projecting into the lumen of the bowel to collapse.

FÆCAL IMPACTION.

From a practical point of view one of the most important conditions to be considered in connection with chronic intestinal obstruction is fæcal accumulation or fæcal impaction. Its chief importance lies in the fact that symptoms really due to an organic stricture are apt to be attributed to fæcal impaction, and this may lead to delay in calling in surgical intervention in cases urgently requiring it. As a matter of fact fæcal accumulation leading to complete intestinal obstruction is rare, and in an oldish patient it certainly is not the first thing that ought to be thought of; whereas, unfortunately, it generally is.

Patients in whom this condition occurs are generally the subjects of long continued constipation and a peculiar sluggishness of the alimentary canal accompanied by the formation of indurated fæcal masses. These masses may give rise to complete obstruction in some cases; in others there is a spurious diarrhœa due to a certain amount of fluid fæces passing down by the side of the inspissated material and to the formation of a quantity of mucus as the result of colitis. The formation of the mass is gradual, and there is no sudden and complete obstruction, such as takes place in connection with a tumour. The symptoms vary from slight discomfort to severe pain and vomiting, which ultimately becomes stercoraceous; if the condition is unrelieved it may be accompanied by all the signs of chronic intestinal obstruction.

The impaction may occur in any part of the large intestine. Usually the fæcal masses are in the rectum, when of course the diagnosis is quite clear. Above the rectum, impaction most frequently occurs in the cæcum and about the flexures, where a definite tumour may form; sometimes the whole of the colon may be one mass of indurated fæces.

TREATMENT.—This varies with the site of the impaction. When it is in the rectum the mass can be felt by digital examination, and an attempt should be made to get it away by soap-and-water enemata. If these fail, six to eight ounces of olive oil should be run into the bowel through a catheter or rectal tube introduced as high up as possible. If the patient can retain this for some time it helps to soften the masses and enemata may then dislodge them. If this fails or if the symptoms are urgent, an anæsthetic should be administered, a speculum introduced, and the mass gradually broken down and scooped

out by a spoon or the finger. A copious oil enema should then be given, and after some hours one of soap-and-water with an ounce of turpentine, so as to soften and clear out any scybalous masses situated higher up.

When the obstruction is higher up than the rectum, the chief reliance must be placed on *enemata* of soap and water or hot water, which should rather take the form of irrigation of the bowel than of an ordinary enema. For this purpose a double tube is often used so that the water can escape freely. This tube is passed as high up the rectum as it will go (usually six to eight inches) and the anus is packed round to prevent the escape of the fluid beside it. The buttocks are elevated on a pillow, and a large quantity of fluid, sometimes several gallons, is run into the intestine by means of a funnel. If the second opening of the tube is blocked and the fluid prevented from running away at once, it will gravitate upwards into the colon and reach the lower end of the fæcal mass, and frequent repetition of these douches will ultimately soften and bring the masses away. The irrigations may be employed three or four times a day for a quarter of an hour or longer at a time. Once or twice a day an ordinary soap-and-water enema containing about a dram of turpentine may be administered. The long tube usually employed in these cases has no particular advantage and in unskilful hands is actually dangerous.

The faradaic current is sometimes employed to produce contraction of the bowel and displace these fæcal masses. One electrode is introduced into the rectum, while the other is applied over the fæcal mass, and a current mild enough not to cause pain is employed. Some surgeons strongly urge the employment of the faradaic current at the very beginning of the case as a means of diagnosis, holding that, if it fails to dislodge the mass, the case is one of stricture and not fæcal accumulation. At any rate, when the mass has been softened by the irrigation and the administration of pure paraffin or small doses of salines by the mouth for a day or two, the current may be employed.

The *drugs* which are most useful are those that give rise to exudation of fluid into the intestine without any violent purgative action, and which also increase the peristaltic power of the intestinal wall. Of the drugs which give rise to exudation of fluid, salines—such as phosphate of soda, in dram doses every four hours, sulphate of magnesia, or one of the various aperient mineral waters, are among the best; pure paraffin, in doses of ʒss, two or three times a day, is often given for its lubricating action. When there are signs that the accumulated materials are softening and tending to move onward, the more active purgatives, such as calomel or castor oil, may be administered. Of the drugs which increase the peristaltic power of the intestine, belladonna and strychnine are the best. Strychnine may be administered subcutaneously (one-thirtieth of a grain three or four times a day). Belladonna may be

given in a pill combined with a little rhubarb and nux vomica, as in the following prescription :

℞ Pulv. rhei. . . . . gr. j.
Ext. belladonn. virid. . . . . gr. ¼.
Ext. nucis vom. . . . . gr. ½.
Misce. Ft. pil. T.d.s.

Salol (ten grains in cachets three times a day) may be employed in the hope of diminishing the decomposition of the intestinal contents and thus lessening the poisoning of the patient. In the more chronic cases abdominal massage is of value. The diet must also be regulated ; substances leaving an insoluble residue should be avoided and the patient encouraged to drink plenty of fluid and take exercise.

It is rarely necessary to consider the question of operation in this condition, except when a malignant growth complicates the fæcal impaction, but when there is an inveterate tendency to chronic accumulation of fæces in the large intestine the question of an ileo-sigmoid anastomosis or even excision of the colon may be considered.

CHAPTER XXV.

INFLAMMATORY AFFECTIONS OF THE INTESTINES.

The inflammatory affections of the intestine may affect the mucous membrane or the appendages connected with the intestine (appendix vermiformis, Meckel's diverticulum, appendices epiploicæ, or diverticula from the intestine), or the peritoneal coat of the bowel (septic and tuberculous peritonitis).

AFFECTIONS OF THE MUCOUS MEMBRANE.

The inflammatory affections of the mucous membrane do not often come under the care of the surgeon, but his aid may be sought under certain circumstances: for example, in membranous colitis, in acute ulcerative colitis, in certain cases of dysenteric ulceration, in perforation of ulcers (*e.g.* peptic or typhoid ulcers), and in tuberculous or syphilitic ulcers.

MEMBRANOUS COLITIS.

This condition most frequently occurs in women, and is commonly associated with constipation. It often occurs in connection with enteroptosis. The most characteristic symptom is the passage of pieces of membranous material and mucus along with the fæces; sometimes casts of portions of the canal may be passed. The patients are usually emaciated, complain of pain (often burning and sometimes colicky), intestinal movements may be seen, and the general health is bad. The patients frequently pass into a neurasthenic condition.

TREATMENT.—The *medical treatment* consists in attending to the evacuation of the bowels, and castor oil or pure paraffin given daily are the drugs on which most reliance is placed; in lavage of the intestine —best obtained by a visit to Plombières, Buxton, or Harrogate; in abdominal massage and exercises; in the use of an abdominal support in cases in which enteroptosis is present (see Chap. XXXII.); and in attention

to the diet—light and easily digestible food being given. Sour milk and lactic acid bacilli were at one time much used, but it is doubtful if the organisms really reach the colon alive. Vaccines of the patient's own bacilli have also been employed with doubtful success. It is only when these methods fail that the patients come under the notice of the surgeon.

The earliest *surgical treatment* employed was to make an opening in the cæcum or the ascending colon with the view of arresting the flow of the fæces through the colon, and of washing out the colon from above. This is, however, an unnecessarily severe procedure. Some surgeons advise the establishment of a communication between the lower end of the ileum and the upper end of the rectum. This, however, leaves the secretions in the colon, and in some cases the fæces run back into the colon and accumulate there. To avoid the latter occurrence, the entire colon has been excised as well, but this is far too severe a procedure apart from the many disadvantages caused by the operation. Experience has shown that all that is required surgically is to establish a small opening in the cæcal region through which the colon can be irrigated, and this is provided for very simply by the operations of appendicostomy and valvular cæcostomy.

Appendicostomy.—The usual 'gridiron' incision for removal of the appendix (see p. 414) is made on the right side and the appendix brought out of the opening and its condition ascertained; if it is normal and patent, the operation is proceeded with, but if it is diseased it must be removed and a valvular cæcostomy performed. If the appendix is normal, it is brought out of the wound until its junction with the cæcum is in contact with the parietal peritoneum. To effect this, it may be necessary to divide the attachment of the meso-appendix to the tip of the appendix for about an inch, but care must be taken not to injure the artery to the appendix, otherwise sloughing may occur. The peritoneum is then stitched to the cæcum around the root of the appendix and the wound is closed. It is well before doing so to make little nicks in the muscles (vertically in the deeper muscles and transversely in the tendon of the external oblique), so that the lumen of the appendix shall not be constricted when the abdominal wall is sutured. A stitch is then passed through the sero-muscular coat of the appendix (taking care not to perforate its lumen) and through the skin of the abdomen so as to anchor it in position (see Fig. 141). After about three days, the projecting portion of the appendix is cut off about a quarter of an inch beyond where it protrudes through the skin, the mucous membrane being left longer than the outer coats so as to prevent closure of the orifice; the mucous membrane is then split and turned over the end of the divided serous and muscular coats and fixed by catgut stitches (see Fig. 142). This small opening does not leak, and a catheter can be introduced into the colon once or twice daily, and the colon flushed out with saline solution, with 0·5 per cent. of protargol, or with astringent lotions, which

are washed out again after a few minutes with saline solution. This lavage should be continued for about nine months. When it is discontinued, the opening contracts and leaves a little mucous dimple with very little secretion; if the patient has permanently recovered, the mucous membrane may be cut away and the opening allowed to heal.

Valvular cæcostomy.—This is practically Witzel's operation (see p. 184) performed on the cæcum. The cæcum is brought forward and clamped, or the ileum and ascending colon are clamped if enough cæcum cannot be brought out. An incision is made into its lumen, into which a No. 12 catheter is introduced, and the wall of the cæcum is folded over the catheter for one and a half inches by a double row of Lembert's sutures (see p. 184), and this part of the cæcal wall is attached to the parietal peritoneum. The wound is then brought together around the catheter, the skin at the point of emergence of the catheter being tucked down to the peritoneum. A tube or plug must be kept in always, but there is no discharge of the contents of the cæcum as in an open cæcostomy. When the patient is well, the opening will close of itself on leaving out the tube.

FIG. 141.—APPENDICOSTOMY. Fixing the appendix to the abdominal wall.

ACUTE ULCERATIVE COLITIS.

This is a much more serious disease, and a large number of the patients die. It is an acute colitis accompanied by the formation of numerous ulcers on the mucous membrane of the large intestine. The condition can be readily diagnosed with the sigmoidoscope. The patient is very ill; there is constant diarrhœa and tenesmus, passage of blood-stained mucus or pus, high and irregular temperature, and rapid pulse. Here early operation is imperative. In some cases an appendicostomy or a cæcostomy may suffice if it is followed by irrigation with saline or antiseptic and, later, astringent solutions. Solutions of protargol (3 to 4 per cent.), Condy's fluid, sanitas, or hazeline, may be employed. In some cases, however, this will not suffice, and then it becomes necessary to arrest the passage of fæces through the colon completely for a time. For this

purpose a colostomy of the ascending colon must be done and a spur should be formed by freeing the bowel, bringing it up to the wound, and keeping the posterior wall forward as in an inguinal colostomy. The chief trouble in connection with this operation is the closure of the opening later on; apart from the difficulty of the operation in this particular situation, the bowel below is apt to become very small if it has been open for a long time.

In *acute dysentery* which is progressing in spite of treatment, we have had success by performing colostomy of the ascending colon followed by lavage of the bowel. In chronic dysenteric ulceration an appendicostomy or valvular cæcostomy will suffice.

Tuberculous ulceration of the intestine is mentioned under obstruction (see p. 369) and again in connection with tuberculous peritonitis (see Chap. XXVIII.). The surgical treatment is an anastomosis of the bowel above and below the affected area. Even when no marked constriction

FIG. 142.—THE METHODS OF ENSURING THE PATENCY OF THE APPENDIX IN APPENDICOSTOMY. In the one case the appendix is split vertically on each side and the two flaps sutured to the skin, and in the other a cuff of mucous membrane is turned back over the cut end of the appendix and sutured in position.

is present, this is a most valuable procedure and may enable the ulcer to heal.

Syphilitic ulceration is usually limited to the rectum and is discussed in connection with diseases of the rectum (see Chap. XXXVII.). It very rarely occurs higher up.

PERFORATED TYPHOID ULCER.

Perforation is not uncommon in typhoid fever, and in a certain number of cases the patient's life has been saved by operation. There is often some difficulty in diagnosing the perforation, however, and it is possible that when the fæcal extravasation is very slight, the condition passes unrecognised and recovery may take place. In typical cases the symptoms are similar to those of perforation due to other causes, and chiefly consist in sudden shock with rapid fall of temperature, intense pain, and violent vomiting.

TREATMENT.—In some cases the patient's previous condition has been so bad and the shock is so profound that it is clearly impossible to intervene, but when the patient is seen within a few hours after the occurrence of the perforation and the general condition is fairly good, the abdomen should be opened through the right rectus, any extravasated material removed, as in rupture of the intestine (see p. 323), and the lower end of the ileum examined for a perforation. This is usually found readily, and an attempt should be made to close the opening. In some cases a few Lembert's sutures will suffice; when the edges of the opening are extremely thin, it may be necessary to cut away the margins of the ulcer, and this should be done in such a way as to make the long axis of the incision parallel to that of the intestine. The opening is closed by a row of Lembert's sutures. The patient is always too feeble to permit of excision of the affected portion of the intestine; moreover the typhoid ulceration elsewhere would preclude such a procedure. The soiled area is then sponged out and a small drain inserted down to the seat of the perforation.

In some cases the perforation has occurred slowly enough for the surrounding coils of bowel to adhere and isolate the infected area so that a local abscess forms; under these circumstances the abscess should be incised and drained in the usual way.

DIVERTICULITIS.

This term was formerly applied to inflammation of Meckel's diverticulum alone, but has now been extended to other diverticula of the intestine not necessarily of congenital origin.

AFFECTIONS OF MECKEL'S DIVERTICULUM.

Meckel's diverticulum is a very important process, for not only may it become inflamed, but it may lead to various other troubles, some of which have already been referred to. It is a persistent omphalo-mesenteric duct, and various estimates of its frequency are given; it is apparently present in one in every 200 individuals. It is attached to the lower end of the ileum, usually from ten to thirty inches above the ileo-cœcal valve; it is generally attached to the convex border of the bowel.

The omphalo-mesenteric duct may remain patent, in which case a fistula is present at the umbilicus. The distal end is, however, usually obliterated, although the tip may remain in connection with the umbilicus either directly or by the intervention of a band representing the obliterated omphalo-mesenteric vessels. In other cases this band may be attached to the mesentery, or the tip of the process may be free; it and the process itself are important causes of internal strangulation.

A free Meckel's diverticulum may give rise to more or less complete intestinal obstruction in various other ways. It may encircle the intestine and even tie knots around it; if full of fæces it may press on the bowel and obstruct it, or may lead to kinks or a volvulus; and it may cause an intussusception, which is often preceded by intussusception of the diverticulum itself. More rarely still, obliteration may occur at both ends, leaving a space in the middle which dilates and forms a cystic tumour.

Inflammation.—Meckel's diverticulum may become the seat of an inflammation closely resembling appendicitis in its symptoms and treatment. It is practically impossible to distinguish between these two affections, and if the appendix is found to be healthy in an operation for supposed appendicitis the ileum should be examined to see if a Meckel's diverticulum is present. The main point of distinction is that the tenderness is not located about McBurney's point as it so often is in appendicitis. As a rule, when the diverticulum is free, the coil of intestine to which it is attached is hanging down into the pelvis, and the pain is lower and more central than it is in appendicitis.

The *treatment* is exactly similar in all essentials to that of appendicitis (see p. 420). The only point in which it may differ is the treatment of the stump of the diverticulum. This is attached to the small intestine, and the ordinary methods of invaginating the stump would not only narrow the calibre of the intestine unduly, but would also leave a projection inside the bowel which might subsequently give rise to an intussusception. The diverticulum must therefore be excised at its attachment, and the resulting opening in the intestine stitched up; if this is inadvisable on account of the inflamed condition of the intestinal wall or because it would produce undue diminution of the calibre of the bowel, the affected piece of intestine must be excised and a lateral anastomosis effected.

OTHER FORMS OF DIVERTICULITIS.

Other congenital diverticula have been found which probably arise as a result of abnormalities occurring in the yolk sac; these are usually in connection with the jejunum or the duodenum. A small accessory pancreas may be associated with these diverticula.

The other important forms are those which are developed in after-life, and which chiefly occur in connection with the colon and especially the sigmoid colon; they have attracted considerable attention in recent years and seem to be by no means uncommon. These diverticula are described as 'true' or 'false' according as their walls are formed of all the coats of the intestine or only of part, and they are usually looked on as acquired. It is, however, possible that they are sometimes of congenital origin.

There are two ways in which the 'acquired' diverticula may arise—

namely, either by traction from without or by protrusion from excessive pressure within the bowel. Traction from without may be caused by a tumour or, more commonly, by adhesion of the intestine to some other structure; an example of the latter condition is seen when the large intestine becomes adherent to the gall-bladder; in this case the diverticulum is composed of all the coats and is a 'true' diverticulum.

In other cases the protrusion is supposed to occur by excessive pressure within the bowel, often in connection with obstinate constipation combined with sacculation and congenital weakness of the wall; this leads to a hernia of the mucous membrane through the muscular coat which may either be completely penetrated or may be represented by a few fibres stretched over the sac, the diverticulum in these cases being of the 'false' variety. These false diverticula are said to occur most often at the mesenteric border, where the muscular wall is weakened by the passage of a blood vessel through it; they may occur at other points in the circumference of the bowel, however, and not uncommonly penetrate into the bases of the appendices epiploicæ. They are often multiple and vary in size from mere excrescences, the size of a pea, to considerable saccules an inch or more in diameter, which then communicate with the bowel by a wide or a narrow opening.

Symptoms usually occur after fifty years of age, but there may be a history of trouble extending over several years.

Diverticula are occasionally found *post mortem* without any symptoms attributable to them having been recognised during life, but generally they are a source of danger to the patient, especially when the wall of the diverticulum contains no muscular tissue and the mucous membrane is in immediate contact with the peritoneum. The diverticulum may become filled with fæces which are not evacuated regularly, and in consequence it is liable to become the seat of severe inflammation. This may take the form of an *acute* inflammation with localised peritonitis which may be comparatively trivial, or a perforation of the diverticulum may occur leading to a general peritonitis or a localised abscess. This abscess may discharge into the bowel, and recovery may ensue, or rupture into the general peritoneal cavity or into a neighbouring hollow viscus such as the bladder may occur; in the latter case a fistulous track between these organs will be formed. In other cases the inflammation is less acute and a certain amount of chronic inflammatory infiltration of the bowel is produced. This may be quite trivial or may lead to the formation of an inflammatory tumour of considerable size, which projects into the bowel and obstructs the lumen from within and also produces stenosis by fibrous infiltration of its wall. Several cases of carcinoma have been reported in conjunction with this inflammatory condition, and it is quite possible that it is an important predisposing cause of malignant disease of the large intestine. It probably accounts for some of those cases of malignant disease in

which there have been attacks of alternate diarrhoea and constipation for many years previously.

This condition is comparatively rarely diagnosed before operation, as there are no symptoms characteristic of an intestinal diverticulum; the usual symptoms are those of peritonitis which might have had other causes. When the affection is situated low down, the condition may simulate carcinoma; there is, however, usually less cachexia, and if the affected region is accessible to the sigmoidoscope, it might be possible to make out that the lumen of the bowel is less obstructed than in carcinoma and that the typical annular ulcer is absent.

TREATMENT.—This will vary according to the symptoms which are produced. Perforation of the bowel, localised or general peritonitis, or abscess, should be dealt with on the lines already laid down. When a definite tumour has developed around a diverticulum, excision of the affected segment of the bowel is probably the best treatment. In the majority of cases this will be performed under the impression that the case is one of malignant disease. But even if the true nature of the condition is recognised, excision should still be performed, partly owing to the probability of obstruction to the bowel, and the possible subsequent incidence of malignant disease, but mainly because there is no other way of getting rid of the diverticula. When the inflammatory mass is situated low down in the pelvis, and there are definite symptoms of obstruction, it may be necessary to perform a colostomy at first, followed at a later period by excision of the mass and lateral anastomosis.

ACTINOMYCOSIS OF THE STOMACH AND INTESTINES.

Something like 20 per cent. of all the cases of actinomycosis affect the abdomen. The infection of the intestinal tract seems to occur generally as the result of swallowing infected meat or grain, or the discharges from an actinomycotic ulcer in the mouth and throat.

The disease very rarely affects the stomach, and though it may occur anywhere in the course of the intestinal tract its most common seat is the cæcum and appendix. We shall refer briefly to the latter condition. Although a superficial actinomycotic infection of the mucous membrane has been noted in one or two cases, the disease usually begins as small nodules in the submucous tissue and these contain the fungus. These nodules soften, destroy the mucous membrane, and form ulcers which run together and increase in size. This ulceration spreads deeply, the peritoneum becomes thickened and adherent to other parts, and especially to the abdominal wall; it is seldom that the ulcer perforates into the abdominal cavity. In some cases a tumour of considerable size forms in the cæcum or appendix and this has usually been removed under the impression that it was a malignant growth. More commonly, however, the disease spreads to the abdominal wall and forms abscesses and

sinuses discharging pus, in which the fungus may be found; these occur most frequently in the loin. In some cases the infection may be limited to the appendix in the first instance, and if it has become complicated by infection with bacteria an appendicitic abscess may form.

TREATMENT.—These cases may go on acutely or may be chronic, but a fatal termination results in the great majority; a few cases have recovered, however, either spontaneously or under treatment. Attempts have been made to excise the affected intestine or appendix, but although one or two cases have recovered, the great majority have died either as the result of the operation or from the spread of the disease. As a rule no radical operation can be thought of, and the surgical treatment consists in opening up the infected area and the fistulæ freely, removing the granulation tissue with a sharp spoon, and destroying the wall of the sinus by the thermo-cautery. Free drainage must be established, and boric fomentations, packing with iodoform gauze, painting the sinuses with tincture of iodine, or irrigating them with peroxide of hydrogen may be employed. These procedures should be combined with the administration of large doses of iodide of potassium. Even though complete cure has only occurred in a small number of cases, considerable improvement and prolongation of life is not uncommon under this treatment.

SYPHILIS OF THE STOMACH AND INTESTINES.

Syphilis of the stomach seems to be very rare, but gummata have been found *post mortem* in a few cases. There are no clinical symptoms which would enable the diagnosis to be made between a syphilitic and a simple ulcer of the stomach; when gastric symptoms arise in a patient with other syphilitic lesions and no definite diagnosis can be made, it is well to bear in mind the possibility of syphilis of the stomach and to give the patient the benefit of the doubt by putting him through a course of antisyphilitic treatment.

Syphilis of the intestine, with the exception of the rectum, which is considered in Chap. XXXVII., is very rare, though somewhat more common than in the stomach; it seems to be more frequent in congenital than in acquired syphilis. In *congenital cases* the small intestine is more often affected than the large, and on *post mortem* examination, small ulcers of the mucous membrane, gummatous infiltration of the muscular coat, and an eruption of small nodules in the various coats have been found. Clinically there is nothing in the symptoms to lead to a diagnosis, but when intestinal symptoms are present in association with other lesions such as syphilitic pemphigus or syphilitic osteo-chondritis, the condition may be suspected; if the suspicion is orrect, the symptoms quickly clear up under appropriate treatment.

In acquired syphilis the small intestine is the more frequently affected.

In the secondary stage an acute catarrhal enteritis may occur, and in the tertiary stage gummatous ulcers have been met with.

Syphilitic strictures occur both in hereditary and acquired syphilis, most commonly in the upper part of the small intestine, but also lower down and occasionally in the colon. They are generally multiple and surround the intestine like tuberculous ulcers. With the exception of the catarrhal enteritis in the secondary stage, the diagnosis of syphilitic ulceration of the intestine is extremely difficult and often impossible. The symptoms closely resemble those of tuberculous ulceration of the intestine, and if they occur in a patient beyond thirty-five years of age and are accompanied by other syphilitic lesions, and the Wasserman reaction is positive, and, further, if they have existed for a considerable time and no definite symptoms of any other condition such as malignant or tuberculous disease are present, syphilis may be suspected. The *treatment* will be that of syphilis, and operative intervention will only be required if strictures have formed.

CHAPTER XXVI.

APPENDICITIS.

THE question whether typhlitis or perityphlitis exists apart from appendicitis is still discussed, but there is no doubt that the diseases formerly classed as typhlitis and perityphlitis were, as a rule, cases of appendicitis, and, although a localised typhlitis or perityphlitis may occur from stercoral or other forms of ulceration, the cases in which severe symptoms are produced, apart from appendicitis, are very rare.

Anatomy.—The vermiform appendix springs from the postero-internal aspect of the cæcum, a little below the ileo-cæcal junction, and is readily found by tracing down the anterior longitudinal muscular band of the large intestine. The root of the appendix is fairly constant in situation and corresponds on the abdominal wall to the spot known clinically as 'McBurney's point'; this is at the junction of the outer and middle thirds of a line drawn from the umbilicus to the anterior superior iliac spine. The process is usually from three to four inches long in adults; it may, however, be considerably longer, and an appendix nine inches long has been recorded. In the infant it is approximately straight and relatively longer than in the adult, while in old age it atrophies concurrently with the other lymphatic structures. The mesentery of the appendix ('meso-appendix') is triangular or sickle shaped, the blood-vessels running along its free border. The arterial supply of the appendix is derived from a branch of the ileo-colic artery which passes behind the termination of the ileum and runs along the free border of the meso-appendix to the tip of the organ, giving off branches to the appendix in its course. From one of its earliest branches, there is a recurrent twig of fair size which anastomoses with the arteries of the cæcum. This probably accounts for the fact that the proximal portion of the appendix may be living although the distal portion is gangrenous.

As the appendix grows it tends to become curled upon itself. Its position varies; but for clinical purposes, three positions or rather sets of positions may be described. It most commonly lies to the inner side

of the cæcum, with its tip pointing either upwards or downwards. In other cases it runs up along the outer or posterior aspect of the cæcum. In a third set of cases it passes over the brim of the pelvis and its tip hangs down into the pelvic cavity. The appendix is completely surrounded by peritoneum except along the line of its mesenteric attachment and usually hangs free in the peritoneal cavity. In some cases, however, when the appendix lies along the posterior aspect of the cæcum, it may be partly retro-peritoneal—that is to say, as the ascending meso-colon fuses with the parietal peritoneum to fix this portion of the bowel, the appendix may be included between the two layers of peritoneum, and when these two layers fuse and disappear, it becomes in consequence retroperitoneal. In some cases no doubt this condition is pathological.

The appendix consists of mucous, sub-mucous, muscular, and peritoneal coats. The first two are rich in lymphoid tissue, and the mucous surface is lined with cylindrical epithelium arranged as in Lieberkühn's follicles; apparently a free secretion of mucus takes place when there is any inflammatory condition. The muscular coat is composed of longitudinal, circular, and spiral fibres—the longitudinal fibres being very scattered or entirely absent at the mesenteric attachment. At the junction of the appendix with the cæcum there is a valve, and a much debated point is whether fæcal matter can penetrate into the appendix under normal conditions. It has been said that the concretions so frequently found in the appendix are really formed in the cæcum and find their way into the appendix; but there seems little reason to doubt that these bodies are actually formed in the appendix itself by the deposit of lime salts, either on portions of hardened mucus or possibly on fæcal material which has passed into the tube. It is true that a material apparently fæcal is not infrequently found in the appendix, but it is a question whether this is true fæcal material, and, further, the appendices in which this is found are diseased.

Pathology.—Appendicitis is an infective lesion, the organisms most commonly concerned being the *Bacillus coli communis* and the pyogenic cocci, especially the *Streptococcus pyogenes*; more chronic cases may also be due to tuberculosis or actinomycosis, but these are rare. The infection most commonly comes from the cæcum, and intestinal stasis and chronic constipation are in all probability important causative factors. In some cases—for example, when it is associated with tonsillitis—it seems possible that the organisms (usually streptococci or pneumococci) reach the appendix through the blood stream. The exact cause which determines the onset of infection is unknown, and many cases of the severest type occur suddenly in patients who were previously in excellent health and who had never been troubled with constipation or any other intestinal disorder. By some observers it is assumed that the appendix does not normally contain fæces and that the entrance of such material into the organ is a cause of the infection. It is certainly very probable

that the retention of fæces in the appendix is a very important factor in leading to infection. The presence of fæcal concretions in the appendix must also play an important part in the etiology of appendicitis, although the large size which they sometimes attain shows that they may remain there a long time without leading to acute disease. Nevertheless, even mechanically, they must keep up a certain amount of irritation, and so strongly predispose the appendix to infection when the active agent comes into play. Once the wall becomes swollen, the presence of the concretion by its pressure may lead to ulceration, gangrene, and perforation at the place where it is situated, and this may explain why perforation so often occurs over a concretion. Foreign bodies, such as pins, needles, thread-worms, and so on, are also occasionally found, and may undoubtedly have caused the trouble. Most cases probably arise from the entrance of virulent bacteria, such as *colon bacilli* from the cæcum, especially when the appendix is predisposed to attack by previous inflammations causing kinking and distortion and stricture of the canal. It seems probable that certain foods may take part in the development of the disease, either by carrying the infective organisms along with them, as in decaying meat, or by lying in a partially digested state in the cæcum, and possibly enabling the intestinal organisms to take on more virulent action.

Appendicitis may be acute or chronic, and the chronic form may become complicated by an acute attack. Acute appendicitis may vary in severity from a simple catarrh of the mucous membrane to acute gangrene of the whole or greater part of the organ.

Acute appendicitis.—In the mildest form, sometimes spoken of as *catarrhal appendicitis*, the mucous membrane becomes somewhat swollen and inflamed, and there is increased secretion of mucus which, however, escapes readily into the cæcum. The attack subsides quickly and the inflammation does not extend to the serous or muscular coats. The appendix may be apparently normal after the attack, but it seems to be more predisposed to further attacks. When, however, the attack is rather more severe, destruction of the mucous membrane may follow in places, leaving more or less *constriction of the canal*, which may be of very serious import if a further attack occurs. In other cases, the attack is more severe either because the organisms are more virulent or for some other reason, and the inflammation extends through the walls to the serous membrane, and lymph is poured out there, which is apt to glue the appendix to various parts in the neighbourhood. In this way *kinks and adhesions* are formed, which, like the strictures above referred to have a serious influence on the course of further attacks, as they must interfere with the escape of the contents. Much more grave are the cases in which *suppuration* occurs in the appendix, more especially if kinks or strictures are present as the result of previous attacks of inflammation. In the latter case the pus cannot escape readily into the cæcum, but accumulates

in the tube of the appendix and ultimately destroys the wall and escapes into the peritoneal cavity. This perforation may be facilitated by the presence of concretions, which, by their pressure against the swollen walls of the tube may lead to limited gangrene and still more rapid perforation. While these processes are going on inside the tube, peritonitis, which is at first plastic, takes place outside, and this may cause the neighbouring intestines or omentum to be glued together and to the parietal peritoneum, so that when perforation occurs, the pus is shut off from the general peritoneal cavity and a localised abscess may form instead of a generalised peritonitis. This localisation is often helped by adhesions resulting from previous attacks. In a good many cases, however, the localisation is very imperfect, and general peritonitis follows the perforation. The severest cases of all, sometimes spoken of as '*fulminating appendicitis*,' are those in which there is an *acute gangrenous inflammation* from the first, probably on account of the extreme virulence of the organisms, no doubt helped by the presence of strictures, kinks, or concretions. Here the gangrene begins in the mucous membrane, which may become a greyish or black mass within twelve hours of the commencement of the symptoms. The gangrene rapidly extends to the other coats until the slough reaches the peritoneal cavity and foul virulent exudation escapes into it. Here there may be no attempt at shutting off the appendix from the peritoneal cavity unless adhesions resulting from previous attacks are present, and the patient may die in from twenty-four to forty-eight hours. On the other hand, however, a considerable number of the less severe gangrenous cases become localised and an abscess forms.

Abscess.—The situation of the pus in appendicitis varies according to the position of the appendix and the part involved. Perhaps it occurs most commonly towards the outer side of the right iliac fossa. Sometimes it develops in the true pelvis—presumably, in connection with suppuration near the end of a long appendix hanging down over the pelvic brim ; in these cases a large abscess may form in Douglas's pouch leading to a matting together of the various pelvic organs, and if the pus is not evacuated, it extends to the left side of the abdomen and may reach the left iliac fossa. In other cases the appendix and the abscess may lie behind the colon, in which case suppuration occurs in the loin, and the pus travels up along the colon and may accumulate between the liver and the diaphragm, forming a subphrenic abscess, or it may make its way through the diaphragm into the pleural cavity and form an empyema, or perforate into the lungs.

If left alone, the abscess gradually increases in size, although there is some evidence that occasionally the pus dries up and disappears. When the pus is shut off by adhesions, it is comparatively rarely that rupture of the abscess occurs into the abdominal cavity, but when there have been injudicious manipulations, or when the bowels have been

much irritated with strong cathartics, such an accident may happen. Most frequently it opens either into the intestine or the bladder. When the suppuration occurs in Douglas's pouch, it is not at all uncommon for the pus to escape through the rectum ; in other cases it escapes through the cæcum or the small intestine. In the latter case fæcal matter also passes into the abscess and thus keeps up the inflammation ; ultimately the suppuration may spread to the skin and a sinus will form giving exit to gas and fæcal matter—a typical fæcal fistula. A fæcal fistula does not form so readily when the suppuration is in Douglas's pouch. Much more rarely the appendix becomes adherent to the base of the bladder, into which the pus may find its way. An abscess on the inner side of the cæcum may gradually extend to the abdominal wall and the pus makes its way out through the umbilicus. When the pus is well to the outer side of the iliac fossa, it may find its way outwards among the muscles above or below Poupart's ligament.

Chronic appendicitis.—Pathologically, there is only one form of simple appendicitis which may be called chronic—namely, *obliterative appendicitis*. Here there is a progressive destruction of the mucous membrane and ultimately complete obliteration of the lumen. This usually begins about the tip and gradually extends along the tube, but it may spread irregularly, forming strictures in the canal and shutting off spaces still lined with epithelium. Obliterative appendicitis is not a dangerous condition if it goes on regularly from the tip upwards and does not suppurate, but infection and the various troubles already mentioned may occur when strictures form or cavities are left.

It must be remembered that appendicitis is very prone to relapse, and previous attacks are apt to render the organ more susceptible. Relapses are especially probable when there is a kink or stricture of the canal or when a concretion is present.

Tuberculous appendicitis, which is also a chronic form, is discussed in connection with tuberculous peritonitis (see Chap. XXVIII.).

SYMPTOMS.—There are few diseases that present such a variety of symptoms as appendicitis, owing in the first place, to the fact that there are enormous variations in the virulence of the infective organisms which may only lead to a trivial catarrh or may set up the most intense septicæmia and gangrene, and in the second place to the varying position and direction in which the appendix lies and its relation to different organs, which become involved secondarily in the inflammation. For example, the appendix may become adherent to the bladder producing irritability of this organ, as evidenced by frequency of micturition and dysuria ; in other cases the inflammation may occur in the neighbourhood of the kidney, and perinephric suppuration may be suspected. Lastly, there is a large train of symptoms, usually described as reflex, such as dyspepsia and malaise, the connection of which with appendicitis is not easily explained, but from the constancy with which these

symptoms disappear after appendicectomy, there can be little doubt that they are due to the diseased appendix ; they, however, often mislead the medical attendant. It will be convenient to describe the symptoms by taking typical examples of varying degrees of severity and describing their clinical course.

In the mildest group of cases the infection is comparatively trivial and does not spread to the peritoneum. In some of these cases there is little to point to the appendix, and the main symptoms are frequently referred to the stomach ; there may be pain after food, flatulence, and general abdominal discomfort. These symptoms, however, are not constant, but come on in attacks without any definite indications as to their cause ; ill-health, over-fatigue, errors in diet, and excessive exercise seem to precipitate an attack. Sooner or later, if the patient is examined while the symptoms are well developed, it will be found that there is a little tenderness at some point in the right iliac region, with slight rigidity of the overlying muscles ; further, on asking the patient to flex the right leg against resistance, abdominal pain may be elicited and sometimes an elongated tumour may be felt in the appendix area. This tumour is not the appendix in the majority of cases, but is a phantom tumour produced by a spasmodic contraction of the muscular fibres of the abdominal wall or by a contracted cæcum. The constitutional symptoms in these mild cases are trivial and the patient generally speaks of them as bilious attacks ; there may be headache, slight anorexia, and, if the temperature is carefully watched, a slight rise may be detected. In other mild cases the pain in the iliac fossa may be more constant, and the patient may have short attacks of severe pain. He is, however, never really ill, and may not have to give up his occupation at all. On the other hand, he is never quite well ; there is a more or less constant dragging pain in the right iliac fossa, which is relieved by flexion of the right leg, there is a certain amount of tenderness over the appendix region, and dyspeptic symptoms may be present. The changes in the appendix in these cases are either simple catarrh of the mucous membrane or obliterative appendicitis ; sometimes a small concretion may be found.

In a second group of cases, which more often come under the notice of the surgeon in the early stage, there are quite definite attacks, during which the patient is decidedly ill. The onset is usually sudden, but it may have been preceded by malaise and abdominal discomfort for a few days. There is usually vomiting at the onset and a considerable amount of pain, which is at first in the epigastric region and colicky in character, but after some hours becomes more constant and referred to the right iliac fossa.

The bowels are constipated as a rule, but there may be diarrhœa. The temperature is sometimes raised to a moderate degree (100° to 102° F.) and the pulse is quickened (100 to 120) ; in other cases the temperature and pulse are very little altered. On examining the abdomen there is

definite rigidity of the muscles over the right iliac fossa, and in some cases a swelling may be felt when this rigidity can be overcome, *e.g.*, by deep breathing. The abdomen is more or less tender at first, but the tenderness soon becomes localised ; indeed, in many cases the whole tender area can be covered by a florin. On examining *per rectum*, a tender spot can sometimes be detected high up and to the right side.

These symptoms point to an appendicitis with extension of the inflammation to the peritoneal surface, both of the process itself and of the intestine in the vicinity ; were the parts exposed, the appendix would be found to be swollen and injected, and it and the various coils of intestine around it would often be more or less glued together by lymph. These symptoms generally indicate inflammation in connection with a concretion in the appendix or with a kink or stricture ; they may, however, indicate an actual perforation; although the symptoms are then usually more severe. The condition generally ends in resolution, but may go on to suppuration.

When resolution occurs, the temperature begins to fall about the second day and generally reaches the normal at the end of the week, and there it should remain if no suppuration has occurred. The rigidity of the abdomen soon diminishes, and the fullness—which is not a hard swelling as it is when suppuration is occurring—rapidly decreases ; in an ordinary attack the patient ought to be well at the end of a week or ten days.

These cases, however, are very prone to relapse, and the relapse may occur either after a long interval of complete health, or the patient may hardly have recovered from one attack before another occurs. These relapses indicate the presence of some of the permanent changes to which we have already referred (see p. 401). Early and frequent relapses usually indicate the presence of a concretion, or inflammation and ulceration of the mucous membrane beyond a kink or stricture. When long intervals occur between the attacks, obliterative appendicitis is not uncommonly found ; this, however, may be complicated with distension and inflammation of the process beyond a stricture.

In some cases the symptoms are not so acute, but the relapses are very frequent. The pain is then often of an acute colicky character lasting at most only a few hours, but not accompanied by any marked swelling, any distinct peritonitis, or much fever ; the patient may be confined to bed for weeks with recurrent attacks of this pain every two or three days. This condition is termed '*appendicular colic*,' and often indicates a concretion or a stricture with distension of the appendix beyond. At any time this appendicular colic may pass into the more serious acute appendicitis.

In a third group of cases the symptoms are much more severe. The onset is more or less sudden, and there is usually severe vomiting and intense pain at first. In some cases there may be a definite rigor and the

temperature may rise rapidly to 102° to 104° F., and the pulse to 100 to 140 and higher. Here again, however, the temperature and pulse may be very slightly affected, although the patient is extremely ill. The tongue is usually furred and somewhat dry, the lips are dry and cracked, and the patient rapidly acquires the typical abdominal look. When the abdomen is examined at the onset of the disease, the tenderness will be found to be widespread, but it will probably be more acute over the iliac region, and ultimately both pain and tenderness become localised to this area if the patient is doing well. Rigidity is a marked feature, and this is also at first generalised, but later on it becomes restricted to the right side where a lump can often be detected. A rectal examination may reveal tenderness, or bulging high up and to the right side. Some cases suffer from troublesome irritability of the bladder. A blood examination shows a marked leucocytosis, which rapidly increases. Of these severe types of cases, there are many degrees, varying from early recovery to abscess formation or general peritonitis. In some cases the symptoms diminish in severity, and a well-defined, localised swelling forms in the right iliac fossa. This swelling is tender and may be either dull or resonant on percussion. If it is large it will usually be dull and will probably be palpable by the rectum; fluctuation will probably be present, but no attempt should be made to elicit this sign owing to the risk of rupturing the abscess wall. Occasionally, the rigidity and tenderness are most marked in the loin, the iliac fossa being comparatively free.

In other cases, again, general peritonitis may be present almost from the onset, while in some the local symptoms may be comparatively trivial, but there may be very severe toxæmia, and the patient passes rapidly into the typhoid state. These cases belong to the group of '*fulminating appendicitis*,' which is the gravest form of the disease. In it one of two distinct events may have happened: a perforation of the appendix may occur suddenly, coincident with or very soon after the onset of the symptoms, or there may be a complete and rapid gangrene of the whole appendix; the latter is the typical form of '*fulminating appendicitis*,' and is that most commonly associated with early and profound toxæmia. In these cases the onset is very much more acute, and, unless speedy relief be obtained by operation, death may occur within two days. The patient is suddenly seized with violent pain in the right iliac fossa, and all the symptoms indicating rapid and severe infection of the peritoneal cavity; these symptoms are most strongly marked in cases of gangrenous appendicitis. In some cases the temperature and pulse may be normal or only very slightly elevated.

In many cases of fulminating or perforative appendicitis there has been no time for the formation of adhesions to shut off the appendix from the general peritoneal cavity, and consequently the result of the perforation or the gangrene is an immediate infection of the peritoneal cavity,

in the first instance in the immediate neighbourhood of the appendix, but rapidly spreading over the whole abdomen. Unless speedy relief be obtained by operation, the patient develops an acute general septic peritonitis. In other cases there may be sufficient old and fresh adhesions to localise the infection, and, if the patient survives the profound toxæmia, an abscess may develop.

Suppuration may occur in connection with any of the severe forms of appendicitis just mentioned, and it may or may not be associated with perforation of the appendix. The cases in which there is no perforation, at any rate at first, must be kept distinct from the former ; in them suppuration is not the initial occurrence, but takes place after a period of peritonitis giving rise to a matting of the intestines around the appendix, which is thus shut off from the general peritoneal cavity. The pus generally contains the *Bacillus coli communis* and pyogenic cocci, and it is not certain which organism is the more active agent in producing the suppuration.

The symptoms vary very much in severity. As a rule they commence quite acutely and present all the symptoms of ordinary acute appendicitis in the first instance. There is often a rigor at the onset, although this is not essential, nor does it necessarily indicate suppuration ; it is always, however, a suspicious feature. After two or three days, the patient, instead of improving as he should do, were the case of the non-suppurative form, continues ill, the temperature remains high, the tenderness increases not only in severity, but in extent, the rigidity on the right side becomes very marked, and a distinct lump, more or less hard in character, may be felt. This lump may be dull on percussion, but it may sometimes be more or less tympanitic. In the great majority of cases, we may assume that, if the acute symptoms last for five days without improvement, suppuration has occurred, and the absence of general peritonitic symptoms implies that this is taking the form of a localised abscess; in young children suppuration occurs more rapidly than in adults. In some cases suppuration sets in after the third or fourth day and then marks the occurrence of a perforation ; the appendix is by that time shut off and only a localised abscess develops. An increase in the severity of the symptoms and the onset of suppuration is often set up by injudicious attempts to obtain an action of the bowels. The patient is prone to attribute his troubles to constipation, and either he or his medical attendant attempts to overcome this by strong purgatives ; there is nothing more calculated to convert a simple into a suppurative appendicitis.

It must not, however, be supposed that, when the symptoms are less severe, suppuration will not occur. It is not at all uncommon for the symptoms to improve after the second or third day, and for the temperature to fall almost to normal, and then to become irregular ; the occurrence of an irregular temperature, several days after the commencement of an acute appendicitis which has temporarily improved, almost

always indicates suppuration either inside or outside the appendix; and this is still more certain if the swelling in the iliac fossa persists or increases in size. In several cases we have found pus around an appendix when, with the exception of the swelling, the symptoms had completely subsided.

We have already described the situations of these abscesses and the course they may take (see p. 403), and it will be evident from what has been said that early operation is desirable. Unless these abscesses be opened early, the patient gradually wastes and goes downhill, even when no general peritonitis occurs, and may die of exhaustion before the pus has made its way to the surface; even when a neglected abscess of this kind is opened, the patient may be in such an exhausted condition that he is unable to recover. Again, when an abscess has been allowed to last for a long time, the cavity may become irregular and one opening may not suffice for drainage; if the drainage is insufficient, the pus extends along narrow channels in various directions amongst the intestines, and thus the suppuration may persist and fresh abscesses may form.

DIAGNOSIS.—The diagnosis of appendicitis may be very easy in some cases, while in others it is very difficult; the diagnosis of acute and chronic appendicitis must be considered separately.

(a) Of acute appendicitis.—Acute appendicitis must be diagnosed from a variety of other conditions, some of which are local abdominal conditions, while others are not. Of the local abdominal conditions the following may be mentioned.

Salpingitis.—This condition often resembles appendicitis very closely, but the symptoms are usually less severe, and in the majority of cases there will be a history of vaginal discharge, and a vaginal examination may reveal fixation of the uterus and the presence of a swelling in one or both of the lateral fornices. *Ruptured ectopic gestation* has a sudden onset combined with signs of internal hæmorrhage, which are usually sufficiently well developed to prevent an error in diagnosis, but it occasionally happens that the hæmorrhage ceases or only occurs very slowly, and the patient quickly regains her colour and the pulse its strength, although it is usually quickened; the temperature is raised, but usually less so than in appendicitis. On examining the abdomen the tenderness is usually lower down and the rigidity is less than would be expected in a case of appendicitis of the same severity; on vaginal examination a fullness can often be felt in one broad ligament, there is bleeding from the uterus, and a history of one or more periods having been missed. *Acute cholecystitis* sometimes has an acute onset with all the constitutional symptoms found in appendicitis. The maximum intensity of the pain and tenderness is, however, situated in the right hypochondrium. In some cases the diagnosis will be facilitated by a history of previous attacks of biliary colic or jaundice. *Perforated gastric or duodenal ulcer*: It sometimes happens that the onset of appendicitis

is accompanied by an acute tearing pain across the upper part of the abdomen, and when this occurs in a patient who has been previously dyspeptic, and is combined with all the other symptoms of acute abdominal mischief, a diagnosis of perforated gastric ulcer may be made. The possibility of the symptoms being produced by appendicitis must, however, be borne in mind, and if no perforation is found, the appendix should always be examined. The reverse error may also occur, more especially in the case of duodenal ulcer, which may be mistaken for acute appendicitis (see Chap. XX. p. 312). As the duodenal contents track downwards, the point of greatest tenderness may be over the appendix, and the patient may not be able to remember where it was situated in the first instance. *Renal colic* must also be thought of, but the absence of inflammatory symptoms and of intestinal complications, and the presence of other signs of renal colic, more especially blood in the urine, will help the diagnosis. In some cases, however, a diagnosis from pyelitis is not easy, especially when the appendix lies behind the ascending colon and its tip is in the neighbourhood of the kidney. We have seen several cases in which infection of the pelvis of the kidney has apparently taken place, and there has been both pus and blood in the urine, and yet the essential trouble has been acute appendicitis. The rigidity of the abdominal wall, the distension of the intestine, the constipation, and the history of the onset, however, all help to make the state of matters clear.

Confusion between an appendicitis and the other acute abdominal conditions just referred to, is not as a rule a serious mistake, inasmuch as these also call for a laparotomy, and the only result of the mistake is that a second incision may be necessary. In some cases, however—for example, in early *pneumonia*—symptoms may be present referable to the abdomen, which may lead to error. The differentiation between appendicitis and pneumonia is very important, and when there are no localising signs of appendicitis the thorax should always be carefully examined, especially towards the right base, as it is a basal pneumonia which is specially liable to be confounded with an abdominal lesion. Occasionally physical signs in the chest are absent, and the diagnosis must then be made by a consideration of the rate of respiration and its ratio to the pulse, by the presence of dyspnœa and movements of the accessory muscles of respiration. Marked movement of the alæ nasi and the peculiar grunting respiration of early pleuro-pneumonia are important signs. The abdomen may be rigid and there may be diffuse tenderness, but these are usually less marked than would be expected in a case in which the temperature and pulse were correspondingly raised. It sometimes happens, however, that during the course of a pneumonia or even without any infection of the lungs, distinct abdominal symptoms occur, due to an invasion of the peritoneum by the pneumococci (*pneumococcal peritonitis*). In these cases there is usually an antecedent

diarrhœa produced by a pneumococcic enteritis, and the physical signs are not localised in the characteristic way in the right iliac fossa. Occasionally there has been some difficulty in distinguishing between *typhoid fever* and appendicitis, but careful examination of the abdomen and the condition of the abdominal wall and of the bowels will usually prevent such a mistake; Widal's reaction will help to elucidate the question.

The above list is by no means exhaustive, and it is only by a careful consideration of all the symptoms and physical signs that an accurate diagnosis can be arrived at.

(b) **Of chronic appendicitis.**—In the case of chronic appendicitis, in which all that the surgeon has to go on is an imperfect history of previous attacks, or in which the symptoms are very indefinite, there may be considerable difficulty in making the diagnosis. For example, it is not always easy to diagnose between *appendicitis* and *mucous colitis*. The two conditions are not infrequently associated; but when in addition to signs of mucous colitis, there are attacks of pain and tenderness in the appendix region, it is generally well to remove that structure. Another common difficulty is when the patient has a *movable kidney*; and in some cases it is not always easy to say how much of the trouble is due to one and how much to the other. The same difficulty may arise in cases of *general enteroptosis*. There a chronic appendicitis may be present, but the removal of the appendix does not necessarily cure the patient's troubles. When the symptoms are chiefly *dyspeptic* or merely indicate some indefinite abdominal trouble, the appendix may not be suspected until a definite attack of appendicitis has occurred.

Tuberculous peritonitis (see p. 449) is another condition which may be found when a chronic appendicitis has been diagnosed. It is only when this is in the early stage and commences in or in the neighbourhood of the appendix (sometimes primarily in the appendix itself) that difficulty will arise; and the removal of a tuberculous appendix or early laparotomy in tuberculous peritonitis is quite a proper procedure. Apart from tuberculous peritonitis, *tuberculous glands* in the neighbourhood of the cæcum may be mistaken for a mass around the appendix. A *calculus* impacted in the ureter will also often give rise to pain and tenderness in the right iliac fossa, and it may be impossible to distinguish these symptoms from those of chronic appendicitis without the aid of a radiogram supplemented if need be by the passage of a ureteral bougie.

When the symptoms are not clear, the possibility that they are due to *gall-stones*, to disease of the *ovary*, *Fallopian tubes*, and other causes, must be borne in mind in deciding on operation.

Nature of the changes in the appendix.—It is by no means easy during an acute attack to come to a definite conclusion as to the form of appendicitis which is present. Two very important points are the

severity of the onset and the aspect of the patient. When an attack of typical appendicitis commences with very severe pain which lasts some time, and passes on into the usual inflammatory condition, the probability is that serious trouble is present—often gangrene or perforation. When the attack begins with rigors, or when there is severe constitutional disturbance, the probability of grave disease is also great ; the presence of diarrhœa instead of constipation is bad, and generally indicates a severe septic condition. The state of the pulse and temperature are unreliable guides, especially if they are not markedly elevated ; on the other hand, the aspect of the patient is of importance. A patient who has had severe pain at the commencement, although it may be much better when the surgeon sees him, whose pulse and temperature are normal or only a little above it, but who has a grey, anxious look, feels ill, and has a dirty or dry tongue, will often be found on operation to have a gangrenous appendix. On the other hand, if the pain at the commencement was moderate, the patient's expression little altered, if the tongue is only slightly furred and is moist, if the temperature is not raised more than a degree or two and the pulse no faster than would be expected with the corresponding temperature, and if there is no lump in the abdomen and the rigidity is not particularly marked, the patient may very likely recover without operation. If under treatment these symptoms subside entirely, or practically entirely, within forty-eight hours, the question of an operation is not immediately imperative. If, however, the symptoms after quieting down begin to increase again and the temperature at the end of the third or fourth day is still raised, pus is probably forming, and an immediate operation is advisable. The diagnosis of the condition of the appendix is, however, so uncertain that it is always a great responsibility in any case to decide against immediate operation in the acute stage.

TREATMENT.—The problem presented to the surgeon is, firstly, whether operation is necessary ; and secondly, if that is the case, whether it should be performed at once or at some future period. Patients come to the surgeon under two sets of circumstances : namely, after they have recovered from an attack and are quite well—*i.e.* during the quiescent stage—or while they are still in the acute stage.

TREATMENT IN THE QUIESCENT STAGE.

The general trend of surgical opinion at the present time is to advise appendicectomy after the patient has had one attack ; for, while it is true that he may not have a second, the probability is that he will, and it may be a serious one ; the risk of an operation in an otherwise healthy patient is much less than that of a second attack of appendicitis. Exception must of course be made in cases in which there is grave constitutional disease, such as uncompensated disease of the heart, advanced Bright's

disease, or diabetes—that is to say, conditions which negative any operation except one of immediate urgency.

Medical treatment.—If the patient refuses operation or if operation is not desirable on account of his general health, he must nevertheless take certain precautions against a fresh attack and employ treatment for his general condition. He must be careful as regards *diet*, especially avoiding hard substances which are not readily digested, such as tough meat, raw vegetables, hard potatoes (it is well not only to mash potatoes, but to put them through a fine sieve); he must also avoid food which is not fresh or which readily undergoes decomposition. As the occurrence of an attack of appendicitis is often associated with decomposition and retention of food in the cæcum, measures must be taken to avoid this. The use of *intestinal antiseptics* is of value, especially naphthaline in three- to six-grain doses in coated pills three times a day after food, salol in ten-grain doses in a cachet, salicylate of bismuth or sodium in five- to ten-grain doses. The regular *action of the bowels* must also be ensured. The patient must not be allowed to become constipated, and if the bowels do not act of themselves mild aperients should be taken. Patients very quickly find out for themselves what laxative suits them best; those most commonly employed are senna-tea (eight to twelve pods) every night, cascara (three to ten grains), aperient mineral waters, or liquid paraffin two to six drams. *Exercise* is necessary, but games which involve violent twisting movements—such as football or tennis—should be avoided, especially soon after an attack.

Operation.—Several operations have been employed for reaching and removing the appendix in the quiescent stage. We need only mention two—namely, the oblique or 'gridiron' method and the vertical incision through (or just outside) the rectus muscle. Each has its advantages and disadvantages.

The advantages of the *'gridiron' incision* are that it does not weaken the abdominal wall and that it is quicker and comes directly down on the appendix in many cases. Its chief disadvantage is that other parts of the abdomen cannot be explored through it, and if the condition of the appendix does not account for the patient's symptoms a fresh incision must be made to explore the rest of the abdomen. If there are very extensive adhesions it may be difficult to deal with them, but more space can be obtained by continuing the splitting of the peritoneum and fascia inwards behind the rectus muscle. The gridiron operation is unsuitable for acute septic cases in whch a free opening is essential; hence it is only employed when the diagnosis of appendix trouble is quite certain, when there is no reason to suspect disease of other organs, and when the operation is performed in the quiescent stage.

The great advantage of the *vertical incision* is that it gives more room, and that various other organs—such as the uterus and ovaries, the gall-bladder and the stomach and duodenum—can be examined and dealt

with by enlarging the incision upwards or downwards as may be necessary. Its disadvantages are that it may not leave such a satisfactory abdominal wall; even though it is carefully stitched up in layers, the abdominal wall may give way and a hernia may result. When the incision is at the outer edge of the rectus, the nerves to the inner part of the muscle may be divided, and even though care is taken to isolate them when making the incision, it is difficult to keep them intact, if a large opening is made. Further, in a muscular individual it is not easy to sew up the peritoneum accurately, the stitches often tear through, and a raw surface is left to which the omentum may become adherent. In cases in which the appendix lies behind the ascending colon it may not be easy to reach it from this incision. Nevertheless, it is a very valuable incision in many cases and is largely employed.

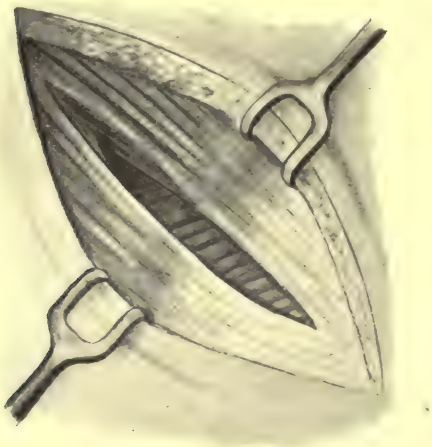

FIG. 143.—THE OBLIQUE OR 'GRIDIRON' INCISION FOR APPENDICECTOMY. *Splitting the fibres of the External Oblique.* The muscular fibres of the internal oblique are exposed.

The oblique incision.—This runs from above, downwards and inwards, with its centre at the junction of the middle and outer thirds of a line from the umbilicus to the anterior superior spine of the ilium; the position of the centre of this incision may, however, be varied if there has been any indication during the acute attack that the appendix is situated higher up or lower down than normal. The incision is carried down to the external oblique tendon, which is split in the direction of its fibres throughout the whole length of the wound (see Fig. 143). The finger is now swept between the external and internal oblique muscles and the tendon of the former is retracted. The fibres of the deep muscles are then separated by sinking in a blunt dissector parallel to the fibres until it has passed completely through the muscles; it is then passed backwards and forwards so as to separate the muscular fibres. The forefinger of the operator is now slipped down by the side of the director and the muscles sufficiently separated to enable him to introduce a large retractor with which the anterior angle of the wound is pulled forwards; if necessary the muscles may also be retracted upwards or downwards, or in both directions (see Fig. 144). The exact point at which to separate the muscular fibres is to some extent determined by the previous situation

of the pain ; when this was higher up than usual, the fibres should be separated a little above the level of the anterior superior spine, and *vice versâ*. When the parts are fully retracted, an area about 2½ by 1½ inches is exposed, which gives ample room when there are no extensive adhesions. If more room is required the splitting of the deeper muscles may be continued inwards until the fibres of the rectus are seen, and this muscle may be pulled inwards and the tissues behind it split still farther ; this gives good access towards the brim of the pelvis. The transversalis fascia and the peritoneum are now divided transversely (see Fig. 145).

The next step is to identify the cæcum. It frequently presents in the wound, and is easily recognised by its muscular bands. If small intestine appears first, it is pushed inwards and the cæcum is sought further outwards and deeper down. The anterior band is seized between the thumb and finger, and the cæcum is gently pulled out of the wound until the lower end of the ileum appears and the ileo-cæcal junction is seen. When this is done, the base of the appendix can usually be recognised, and the finger should be slipped down along it in order to ascertain if adhesions are present ; if so, and, if they are quite fine, the finger will tear them across and allow the appendix to be brought out into the wound. As the head of the cæcum is pulled out, the upper part is tucked back into the abdominal cavity.

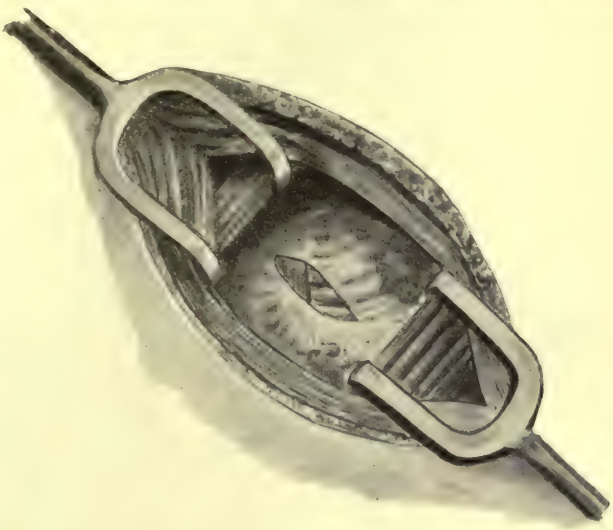

Fig. 144.—The Oblique or 'Gridiron' Incision for Appendicectomy *Splitting the Internal Oblique and Transversalis Muscles.* The peritoneum has also been opened and the cæcum is seen beneath.

The appendix is now separated, and the best way of freeing it is to begin from the tip of the process, which must be exposed as fully as possible by pulling the edges of the wound to whichever side may be necessary. Any adhesions are then gently detached with the finger or a dissector and divided. This must be done with the greatest care and not in the dark. When the appendix has been separated right up to its attachment to the cæcum, the meso-appendix is clamped and ligatured in sections until the base of the appendix is reached.

It is quite impossible to give exact directions for dealing with all the difficulties met with in actual practice; but the principle on which the surgeon should proceed is first to find the lower end of the cæcum and the ileo-cæcal junction, and identify the base of the appendix, and then to follow it down towards the apex. The base of the process is identified either by sight or by grasping the cæcum below the ileo-cæcal valve

FIG. 145.—THE OBLIQUE OR 'GRIDIRON' INCISION FOR APPENDICECTOMY. *Exposure of the Cæcum.* The method of using the retractors is seen.

and rolling the appendix under the finger. The latter plan is particularly useful when the adhesions have extended over the cæcum and the appendix so as to obliterate all trace of the actual attachment of the two structures. When once the appendix is felt rolling under the finger the adhesions over it may be separated and its base defined without great difficulty; then, working downwards from the base, the adhesions are separated and the appendix defined. If the appendix is adherent to the

intestine, the bowel may be injured in trying to peel it off; or again, the cavity of the appendix may actually communicate with that of the intestine at the point of adhesion, and detachment of the appendix inevitably leaves a hole in the latter. Should such an accident happen, the hole must be stitched up as in ordinary intestinal wounds (see p. 324). Further, when the tip of the appendix is deep down and firmly adherent, it may be torn off if the surgeon is too rough or if he cannot see what he is doing. If this accident happens, the wound must be enlarged by dividing the muscles, and the tip of the appendix sought for and removed. In both cases the wound is apt to become septic, and therefore a drainage tube should be left in it.

It is sometimes found that, while the base of the appendix is well exposed, the process is very long and its tip is firmly adherent at some distance away—for example, high up behind the colon or low down in the pelvis. It is most important not to attempt to detach it blindly with the finger unless the adhesions are quite soft and easily separable; if it is firmly adherent it is essential to see what one is doing. When it is in the pelvis, enough room may be gained by splitting the deeper structures towards the middle line and retracting the lower part of the wound (see p. 413). When it is adherent high up behind the ascending colon, the following plan has answered admirably: After the position of the tip of the appendix has been ascertained, the external oblique is, if necessary, slit up farther and then a second splitting of the internal oblique and transversalis muscles is practised parallel to the original one and over the tip of the appendix, and the abdomen opened at that spot. The tip of the appendix can now be got at through this second opening and the whole process safely separated and brought out through one of the openings, generally the lower. This plan is better than that of dividing the muscles, in that it does not weaken the abdominal wall.

FIG. 146.—THE 'CUFF' METHOD OF REMOVING THE APPENDIX. *Fashioning the Cuff.* The meso-appendix has been ligatured and divided, an incision carried around the base of the appendix and a ligature applied around the muscular and mucous coats.

Removal of the appendix.—When the appendix is quite free and all hæmorrhage has been arrested, the head of the cæcum and the appendix itself are pulled as far out of the wound as possible so as to complete the operation outside the abdomen. There is no difficulty in doing this in

the majority of cases ; at most, a few adhesions binding down the cæcum may have to be divided before the latter is sufficiently freed. It is much easier and better to deal with the stump of the appendix outside the abdomen than at the bottom of the wound.

Various methods are employed which differ in detail, but the practical result seems to be the same. The following is a method which is frequently employed. The peritoneal coat is divided by a circular incision about half an inch from the cæcum, and turned aside as a cuff, exposing the muscular coat (see Fig. 146). This can usually be done quite easily, except in those cases in which the peritoneum is adherent to the musclar coat : the cuff is not really essential, but is a useful additional precaution against perforation. As the cuff is reflected, one or two fair-sized branches of the appendicular artery will be exposed, and it is well to divide these with a fine pair of scissors to prevent tearing the cuff. The contents of the

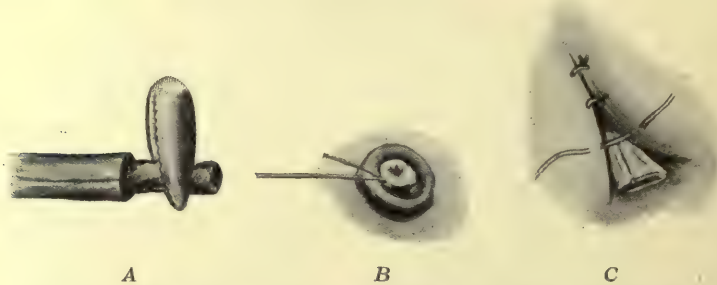

FIG. 147.—THE 'CUFF' METHOD OF REMOVING THE APPENDIX. *Burying the Stump*. *A* shows the muscular and mucous coats of the appendix grasped with Spencer Wells's forceps on the distal side of the line of section. *B* shows the ligature round the divided stump of the appendix and the reflected cuff of peritoneum outside it. *C* shows this stump—the cuff of peritoneum having been turned forward again—being buried in the cæcum by means of Lembert's sutures.

appendix are next pressed away from the neighbourhood of the base, and the appendix is clamped with a pair of Spencer Wells's forceps, about half an inch from its root, so as to prevent the escape of its contents when it is divided. A catgut ligature is then tied round the muscular and mucous coats of the appendix as close to the cæcum as possible, and a piece of sterilised gauze is wrapped round the root of the appendix between the cæcum and the ligature, so as to prevent any soiling of the field of operation by the contents of the appendix, the gauze being held in position with a pair of Spencer Wells's forceps. The appendix is then cut off and the mucous membrane from the stump carefully removed with a small spoon—such as that employed for evacuating Meibomian cysts ; the bare surface left is thoroughly cauterised with undiluted carbolic acid, which is then washed away with saline solution. The gauze is now removed, the ligature cut short, the cuff pulled back over the stump of the appendix, and the whole buried in the wall of the cæcum by a few interrupted Lembert sutures (see Fig. 147).

Instead of dealing with the stump of the appendix in this manner, some surgeons, after making a circular incision through the serous coat, prefer to crush the remaining portion of the appendix wall with a pair of pressure forceps, and then cut off the appendix beyond these with a knife or a pair of scissors ; no ligature is applied. A continuous suture is inserted in the cæcal wall around the appendix about a quarter of an inch from its root ; when this is tightened it acts as a purse-string (see Fig. 148). A probe is then placed upon the apex of the stump, which is gently pressed into the cæcum and buried by tightening the purse-string suture. It is well to bury the dimple thus produced in the cæcum by continuous Lembert suture. This 'purse-string ' suture is especially useful when the cæcum cannot be brought well out of the wound.

Fig. 148.—The Purse-string suture for burying the Appendix Stump. The purse-string suture does not run right round the base of the appendix. After being carried along one side it is inserted near its original starting-point and carried round the opposite side. When the two ends are tightened it gives an admirable pucker, and the stump invaginates very easily.

The vertical operation.—In this case a vertical incision about three inches long is made over the rectus muscle with its centre opposite the umbilicus. It runs about half an inch internal to the right semilunar line, and is carried through the anterior sheath of the rectus until the muscle is reached. The fibres of the muscle are then separated or its outer edge exposed after peeling the anterior layer of the sheath outwards, and the muscle drawn towards the middle line. The posterior sheath is thus exposed and is divided in the same position as the anterior (it will be deficient at the lower part). The deep epigastric vessels are seen on the under surface of the rectus, and should they bleed they must be tied. The transversalis fascia and the peritoneum are then divided. The condition of the appendix and cæcum is now ascertained, and then the hand is introduced into the abdomen and the pelvic organs, the gall-bladder, the stomach, and the duodenum are examined in that order The kidney and ureter should also be palpated. If necessary the wound can be extended upwards and downwards to enable the surgeon to deal with any lesions which may be found—such as fibroid tumours of the uterus, gall-stones, or ulcer of the stomach or duodenum. The appendix is then removed and the wound is stitched up in layers.

After-treatment.—This is described on p. 427. If the operation has been a long one, a pint of normal saline solution should be run into the rectum as soon as the patient is put back to bed, or in more severe cases continuous saline proctoclysis may be employed. If there is much pain one-sixth of a grain of heroin may be injected subcutaneously ; but if a further sedative is necessary, fifteen-grain doses of aspirin may be used. Morphine or heroin tend to produce paresis of the intestines and increase the flatulence.

TREATMENT IN THE ACUTE STAGE.

The view is gaining ground that the wisest course is to remove the appendix in all cases without delay as soon as appendicitis is diagnosed, and in our opinion if this course were generally adopted many severe attacks would be avoided and the death-rate diminished. The symptoms of acute appendicitis are so deceptive that it is often impossible to say whether the attack is to be a mild or a severe one. On p. 404 we have indicated some points which may help in coming to a conclusion, and especially those which indicate a grave state of matters. In the latter set of cases there should be no hesitation in urging operation as early as possible; but even in cases which begin mildly, although many of them recover, yet they may change their character, and complications may ensue; and as the operation early in the attack is in the great majority of cases a clean one, operation immediately the diagnosis is made is the wisest course.

When, however, the disease is established and has lasted for some days before the surgeon is called in, opinions differ as to the period at which the operation should be performed, some advising delay in the hope that the inflammation may subside, or that an abscess, if forming, may become well localised, others advising immediate operation. If the case is a mild one and the symptoms are rapidly improving, delay is permissible and appendicectomy may be deferred until the attack has passed off, but in all other cases we believe that immediate operation is the wiser course.

Those who delay operation when it is fairly obvious that pus is present do so in the hope that the abscess may become adherent to the abdominal wall, and that it may be evacuated and drained without opening the general peritoneal cavity. But it must be borne in mind that the swelling in which the appendix lies and in which the pus forms, is situated towards the deeper part of the abdomen in the great majority of cases and may not—except in the cases in which the pus is behind the ascending colon—become adherent to the abdominal wall for some time, if at all, and in the meantime the patient is subject to all the risks referred to on p. 430. Further, when the abscess is large, the surgeon must in many cases be content with opening it, and it is seldom that the appendix can be removed at the same time without defeating the object of the delay—that is to say, without opening the general peritoneal cavity. The removal of the appendix is, however, a very important matter in these cases. If the abscess is merely opened, it may not heal until the appendix has been taken away, and even if it does, the patient is liable to further attacks of appendicitis; thus appendicectomy will be required in either case at a later period. For these reasons, therefore, we cannot agree with the policy of delay.

If the operation is deferred in the milder cases it should not be put off too long, and should be performed as soon as the patient has recovered and before he has passed out of the hands of his medical attendant; indeed, in most cases he should be kept in bed—or, at any rate, under close observation—until he is operated on. If there is no sign of peritonitis, as indicated more especially by obstinate constipation, or of the presence of a lump, or of a diffuse tender area, a few days will suffice; if, on the other hand, there has been evidence of peritonitis—and especally if there has been a swelling—the surgeon may wait until these symptoms have entirely passed off and the swelling has completely subsided; while waiting, the patient should be kept in bed, active purgatives should be avoided, and the diet should be restricted. If these precautions are not followed, the inflammation may recur and an abscess may still form.

Non-operative treatment.—When for some reason—such as refusal on the part of the patient to submit to early operation, the presence of other diseases, such as diabetes or heart disease, which greatly increase the gravity of operation, or the rapid subsidence of the symptoms—delay seems expedient, the treatment should be conducted on the following lines. The first essential is to put the patient to bed with the knees flexed over a pillow, and he must be kept perfectly quiet and not allowed to move about. While the vomiting lasts, *food* should not be given by the mouth, but frequent sips of hot water may be allowed. The vomiting generally passes off in a few hours and the patient may then be given liquid food, such as milk with lime-water or liq. calcis sacch., or small quantities of meat-juice or soups; but the amount should be limited, and if the patient will submit, it is best to give him nothing at all for several days except water. No solid food should be allowed until the acute symptoms have passed off. Stimulants are generally unnecessary and are better avoided. *Salol* in five- to ten-grain doses in cachets, or *naphthaline* in three-grain pills, should be given three times a day as an intestinal antiseptic. On no account should purgatives be administered in the early stages; a common mistake is to pay too great attention to the constipation, and violent efforts are often made to bring about an action of the bowels quite early in the disease, and this no doubt is, to a great extent, the patient's fault, because he feels that if his bowels would act he would be much relieved. The utmost that should be done—and that only with caution—is to give a *soap-and-water enema*; in the first two or three days even this is unnecessary.

The advisability of administering *opium* has been much debated. When the patient suffers much pain there is a great temptation to give this drug, and it is held by some to be advantageous also because it diminishes peristaltic action and so gives the bowel rest. But opium masks the symptoms, and a patient under its influence may be so comfortable that it is impossible to judge properly as to the progress of the disease. If the pain is acute, the smallest dose of opium sufficient to quiet the pain should

be given, and only if it is absolutely necessary and after a surgeon has seen the case and decided as to the question of operation.

Among the *local applications*, cold is the best in the early stage if the patient can put up with it; an icebag or Leiter's tubes with water running through them at a temperature of 50° to 60° F. are very useful. In the later stages, however, the patient generally derives more comfort from hot fomentations. Blisters or counter-irritants should not be employed, as it may be necessary to operate at any time, and the skin must therefore be kept in as healthy a condition as possible. Leeches are sometimes employed, but they are not likely to arrest a suppurative appendicitis, and they damage the skin and interfere with the subsequent operation, should one become necessary.

When the temperature has fallen, and the abdomen is becoming less tender, enemata and saline aperients may be given so as to clear out the bowels. The simplest plan is to commence with dram doses of sulphate of soda every four hours until the bowels act; when there has been constipation for four or five days it will often be two days before the bowels act under this treatment. Enemata may be employed coincidently but neither the surgeon nor the patient need be in a hurry to obtain a complete action of the bowels; the constipation will pass off with the cessation of the inflammation. Violent attempts to open the bowels only aggravate the inflammation; indeed, recurrence of the disease ending in suppuration may follow the administration of strong purgatives when the primary attack has apparently subsided. The patient should be kept in bed for several days after the temperature has fallen to normal and until any thickening present has disappeared.

Operation.—Perhaps the best way of making the operative treatment of the acute stage clear is to divide the cases into three groups, according to the time which has elapsed since the commencement of the symptoms —namely, during the first twelve to twenty-four hours; after that period up to the end of the fifth or sixth day; and at a later period when a circumscribed acute abscess has formed. This is only an arbitrary division, but it corresponds to a certain extent with the pathological conditions present, although they vary much in rapidity and character. For example, during the first twelve hours, it is rare—except in the case of immediate perforation—for the infection to have spread to the peritoneal cavity and set up a general peritonitis. From that time onwards, if the disease goes on, the appendix may have perforated, or gangrene may have occurred and spread through all the coats, the peritoneal cavity is becoming infected either generally or locally, and pus is beginning to form. Again, if the patient survives for five or six days the abscess is circumscribed and continues to enlarge, and may become adherent to the abdominal wall. The last two periods, however, merge into one another very much; in children, for example, there is often a considerable abscess before the fifth or sixth day, but even then it will

probably not have reached and become adherent to the anterior abdominal wall. Finally, we shall discuss the treatment of various complications which may arise during the treatment of the case.

1. Operation during the first period.—In all operations performed during the acute stage the opening must be free and the surgeon must see what he is doing. Hence during this period the vertical incision through the linea semilunaris is the best. The further procedures depend on the condition which is present. In most cases a little fluid escapes when the peritoneum is opened, but if it is clear or only slightly turbid it does not necessarily imply infection of the peritoneum, and may be disregarded. In a good many cases operated on within a few hours of the onset of the symptoms, the inflammation in the appendix may not yet have reached the peritoneal coat, and in that case the further procedures are the same as in the operation in the quiescent stage, and the wound in the abdominal wall may be subsequently stitched up in layers without a drainage tube.

If the fluid which escapes is turbid and the condition of the peritoneum is suspicious, it is best to leave in a medium-sized drainage tube leading down to the bed in which the appendix lay. If after two or three days there is no sign of sepsis the tube is removed and the wound allowed to close. If sepsis should occur, the part will in all probability be shut off by that time; but the drainage tube should be retained and gradually shortened as in an ordinary septic wound.

If it is found that the appendix has ruptured, the wound must be enlarged for a sufficient distance to give thorough access, the healthy intestines packed away by a roll of gauze, the appendix removed, and the cavity in which it lay thoroughly mopped out. A large drainage tube is introduced to the bottom of the wound, and some gauze packed around it in the manner described on p. 426 and the wound left open. One or two through-and-through stitches (see p. 219) may be introduced at each end of the wound in order to diminish its size, but no buried stitches should be employed, otherwise they may become infected and have to be extruded from the wound before healing is complete. We cannot convince ourselves that it is good practice, as advised by some, simply to mop out the cavity and close the abdominal wall without drainage in these cases as if the case were in the quiescent stage.

2. Operation during the second period.—In these cases a swelling may or may not be felt before the abdomen is opened. If present, it will be composed of intestines and omentum matted around the appendix, and there may or may not be pus in the middle of it.

When no distinct lump is felt, the usual oblique incision is made, its centre corresponding to the supposed situation of the appendix, and the muscles may be separated, care, however, being taken that in doing so the surgeon does not press inwards, lest he should displace pus. When the peritoneum has been opened, the edges of the wound are retracted, and

when the situation of the appendix is defined—as indicated by matting of the parts—the muscles should be divided upwards or downwards sufficiently to give a complete view of the parts beneath. In these cases the surgeon should never work in the dark, but should always have complete access to, and be able to see, the part with which he is dealing, otherwise he may infect the general peritoneum badly, or tear the appendix, the bowel, or the mesentery.

When a distinct lump is felt, the incision is made over it, or rather to its outer side. If it is in the iliac fossa the incision may be oblique, but the muscles should not be split, but divided to the same length as the incision in the skin. The presence of a mass implies a serious state of matters: certainly a local peritonitic infection and probably more or less pus. The possibility of a hernia afterwards becomes a secondary consideration under these circumstances compared with the necessity of saving the patient's life. If the mass lies towards the pelvis or if one has been felt in the pelvis through the rectum, a vertical incision through the lower and outer part of the rectus must be employed. If it is above the crest of the ilium, the incision should be made somewhat obliquely in the loin, its lower end reaching down in front of and a little below the anterior superior spine of the ilium.

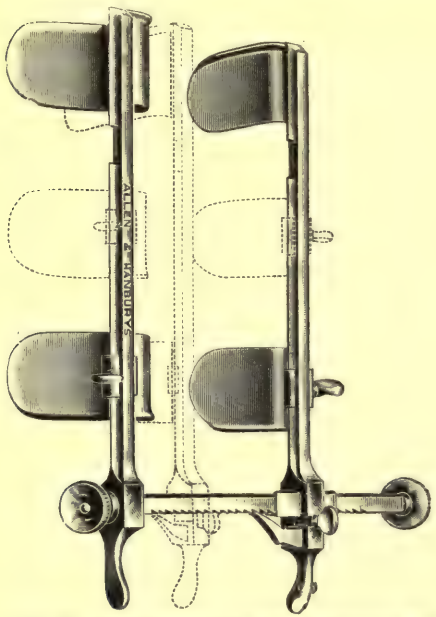

FIG. 149.—SELF-RETAINING ABDOMINAL RETRACTOR FOR APPENDIX OPERATIONS. By means of this instrument a wide variation in the size of the opening may be obtained. It is very useful when the surgeon is short-handed or the abdominal muscles are rigid.

When a satisfactory opening into the peritoneal cavity has been made, a general idea of the conditions present may be obtained by passing the finger into the abdomen with great gentleness so as not to rupture any collection of pus which may be present. The next step is to pack away the intestines and omentum which lie over and around the swelling so as to get a clear view and also to prevent them from being soiled during the subsequent manipulations; care must be taken to pack downwards towards the pelvis and upwards towards the loin, as pus is put to run in these directions. This packing may be done with a roll of plain sterilised gauze or with large abdominal pads. We prefer the former, because, being in one piece, the gauze is not liable to be over-

looked. When, however, the intestines are much distended, large abdominal pads will keep them out of the way better. Fig. 149 shows a good form of self-retaining retractor for use in these cases.

The swelling is now examined; if omentum is adherent to it, this must be gently detached, careful watch being kept lest in doing so pus should ooze out. The anterior band of the cæcum is then looked for, and the ileum and ileo-cæcal valve are identified and guide the surgeon to the appendix. After re-arranging the packing so as to expose the appendix and at the same time to catch anything which may run down to the more dependent parts, the mass is opened up. If the root of the appendix can be seen, it is easy to follow it down and separate it by the finger and a blunt dissector from the parts to which it is adherent. Special care must be taken in detaching the tip as it is often the most diseased part and may rupture or even tear off, in which case it will be very difficult to find it; this is more especially the case if it is adherent to the rectum. While the surgeon is separating the appendix the assistant must be ready with sponges to mop up any pus which may appear, and if an abscess of any size is found the opening must be enlarged and all the pus mopped out before the further separation of the appendix is proceeded with. Not only must care be taken not to rupture the appendix during its removal, but also not to injure any structure—*e.g.* intestine to which it may be adherent—because that also is generally softened by the inflammation. If the adhesion to intestine is firm, it is often best to strip off the peritoneal coat of the appendix at the point of adhesion and leave it behind if it is detachable; this avoids injury to the wall of the intestine and is often the only safe way of dealing with adhesion of the tip of the appendix to the rectum.

After the appendix has been freed, the meso-appendix is clamped and divided (see p. 417) and the appendix is wrapped in a sterilised gauze swab so as to prevent further soiling of the wound. In some cases the root of the appendix is fairly healthy and a peritoneal flap can be peeled up and the appendix removed in the manner described on p. 417; but in most cases this is not possible, and then the appendix should be clamped high up, its root tied with catgut, and cut away between the forceps and the ligature. The stump should be scraped out and touched with undiluted carbolic acid in the usual manner and an attempt made to bury it. This is a most important thing to do with the view of avoiding a fæcal fistula, but it is sometimes very difficult because the wall of the cæcum is often swollen and indurated, and the stitches simply cut through. A purse-string suture, applied some distance away from the stump, the needle taking up the whole thickness of the muscular coat, is more likely to succeed than any other plan. If the stump cannot be covered in this way it may be possible to fix a piece of peritoneum or omentum over it.

Preparations are now made to drain the wound and promote rapid

adhesion of the intestines, thus shutting off the septic area. The introduction of drainage tubes alone does not seem to be enough; they do not lead to rapid adhesions around and the infection may spread to the general cavity. On the other hand, if the drainage tubes are packed round with gauze the area is quickly shut off. It is remarkable how quickly adhesions form when the peritoneum is in contact with gauze; the intestines will be sticking together sometimes in fifteen to twenty minutes,

FIG. 150.—THE DRESSING APPLIED FOR A CASE OF SUPPURATIVE APPENDICITIS. The tube is seen in the centre, and around this is the gauze packed in between it and the large outside sheet of gauze, which is put in first and shuts off the operation area from the peritoneal cavity.

whereas it may be hours before this occurs with tubes alone. We have tried both plans, and almost the only cases in which infection has spread have been those in which we have simply introduced drainage tubes and have not employed gauze packing in addition. No doubt the removal of the packing is not an easy matter, but with care and patience it can be done quite safely. The following is the best plan of introducing the packing. Take a largish single layer of gauze, and in the middle of it place the end of a large drainage tube. As the tube is inserted into the wound, it carries the gauze with it and when it has

reached the bottom of the wound, the funnel of gauze is spread out and a fresh strip of gauze is lightly packed in between it and the tube (see Fig. 150). When inserted in this way the greater part of the packing which lies around the tube can be pulled out comparatively readily, the only part which adheres firmly being the envelope. If the cavity is large or tortuous one tube may not suffice, and similar tubes must be inserted into the other recesses. This gauze packing not only sets up adhesions and drains away serum, but it also prevents the escape of intestine should the patient vomit or strain. The wound should be left quite open in most cases, but if it is large one or more through-and-through stitches of silkworm-gut or silk may be put in at each end, but there should be no marked narrowing of the opening. The ordinary antiseptic gauze dressings should now be applied and fixed on with a firm many-tailed bandage.

After-treatment.—*General treatment.*—The patient is put back to bed, and it is well to place him in the 'Fowler position,' *i.e.* to prop him up on pillows in a semi-erect posture. The idea of this is that any discharge which forms shall run down towards the pelvis, which is less dangerous than if it ran upwards towards the diaphragm. As a matter of fact, however, the importance of this position has been greatly exaggerated in these cases, for if the wound is packed in the manner we have described, the infected area is shut off very quickly and the discharge wells out of the tube and does not spread in the abdominal cavity. In general peritonitis, however, it is very useful, and even in the above cases, the patient is more comfortable in this position if it is not carried to an extreme.

Saline infusion is of great value in these septic cases, and as soon as the patient is put back to bed, a pint of normal saline solution should be introduced into the rectum, and it is well to add to it twenty grains of aspirin and thirty grains of bromide of potassium so as to diminish the post-operative pain. If he cannot retain the solution in the rectum, as is not infrequently the case at first, the saline solution (without the aspirin and bromide) should be injected into the axillæ (about twelve or fourteen ounces into each, and later on continuous saline proctoclysis (see Vol. I. p. 115) should be employed for several hours. If possible, morphine should be avoided, as it increases the flatulence and the tendency to paralytic distension of the bowels, and more aspirin and bromide should be given instead; if that does not act, small doses of heroin (gr. $\frac{1}{12}$) may be used. If, however, scopolamine and morphine or atropine have been administered before the operation, as is often done, the after-pain is generally slight.

The chief troubles after operation in these cases are from flatulence and sleeplessness. For the former the administration of eserin or pituitary extract, the use of the long rectal tube, and enemata containing rue, assafœtida, or turpentine (see p. 211) should be employed. After thirty-six to forty-eight hours attempts should be made to get the

bowels to act. The sleeplessness is often most distressing and persists for several days in spite of all sorts of narcotics.

At first nothing should be given by the mouth, except sips of hot water, and in any case it is better not to force nutriment for at least twenty-four hours. After that he may have beef tea, chicken broth, milk, and barley water, albumen water, raw-meat juice, tea with biscuits or toast. As soon as the bowels have acted, he can have semi-solid food, and may have ordinary diet in a week or ten days.

Local treatment.—The outer dressing should be changed daily or oftener if it becomes very foul, as is not uncommonly the case, but there should be no meddling with the packing or the tubes and no syringing at first. On the second day, very gentle traction may be made to see if any of the packing will come away, but no serious attempt should be made to remove it till the third day ; even then, only a small portion of it will be got away, as a rule. In adults the gauze can generally be removed without an anæsthetic, but in children it is advisable to administer one. The removal must be done with gentleness and patience, so as not to damage the adhesions, and will sometimes take an hour or more. If the gauze is pulled out quickly and forcibly, the adhesions may be broken down and the whole aim of the packing undone ; indeed, it has happened under such circumstances that bowel has come out of the wound and has of course become soiled. The removal of the gauze is much aided by injecting peroxide of hydrogen (10 vols.) into the tube and on the gauze ; it bubbles very much and loosens the gauze. In the first place only the interior gauze should be dealt with by pulling on a small piece at a time, then taking a fresh piece and irrigating freely with the peroxide of hydrogen, this portion will come away fairly easily, leaving the tube and the gauze envelope still to be removed. It takes some time to remove the interior mass of gauze, and if it is still firmly adherent it is well to leave the final removal until next day ; if not it may be removed at once. In any case the next thing to do is to take out the drainage tube, which comes out quite easily, and then the removal of the remainder of the gauze is proceeded with. A fresh drainage tube should be ready for insertion at once, otherwise the sides of the canal may fall together and it may be difficult to get the tube down to the bottom of the wound. Some gauze should be lightly packed into the upper part of the wound for some days, so as to prevent the intestines bulging out between the edges and interfering with their proper closure. Subsequently the wound is syringed out with peroxide of hydrogen every day until it becomes odourless, when it is best to leave off syringing altogether. The drainage tube should only be shortened as it is pushed out, and the cavity is thus made to heal from the bottom. If it is left out too soon, accumulation of pus takes place and the wound has to be re-opened, and thus its ultimate closure is delayed. An average time for the healing of these cases is about five

weeks, and it is well to keep the patient more or less recumbent for that time. When he begins to get about, he should wear a belt with a large pad over the cicatrix. If no hernia is evident after about a year, the belt may be discarded. A considerable number of cases in children and young adults recover without any hernia, but in older people hernia is common after suppuration in the abdomen. If a hernia occurs it can be repaired later on (see Chap. XXX.).

In some cases free pus is found on opening the abdomen ; in other words, the infection has spread to the general abdominal cavity and general septic peritonitis has occurred. The peritonitis may be still limited to the neighbourhood of the appendix and in that case the pus should be mopped up and the appendix removed, the procedure being similar to that detailed above. In other cases, however, the infection is more widespread and the case is one of general septic peritonitis following on appendicitis. The treatment of septic peritonitis is similar to that for the same condition occuring after rupture of the bowel, and is considered in Chap. XXVIII. ; here we may say that although the peritoneum may have become generally involved, the appendix should, nevertheless, be removed, otherwise the patient will have little or no chance of recovery.

3. Operation at a later period when a large circumscribed abscess is present.—Here there may be two different conditions, according as the abscess is or is not adherent to the abdominal wall.

If it is not adherent to the abdominal wall, the problem is similar to that in the second set of cases—namely, to evacuate the pus across a healthy peritoneal cavity, and at the same time prevent a general infection of that cavity. The conditions differ, however, in that here there is a much larger collection of pus to deal with and that probably the pus is not so virulent. The operation is similar to that just described up to the evacuation of the pus (see p. 424). A small opening is then made into the abscess and the pus steadily mopped away as it escapes ; then the opening is enlarged and the pus is sponged out of the abscess cavity as thoroughly as possible. The question now arises whether the appendix should be removed or not. It is a great advantage to remove the appendix if possible, as the wound will heal more rapidly and satisfactorily and with less risk of an obstinate sinus ; there is also less chance of other complications and there will be no necessity to operate at a later period for removal of the appendix. Hence if it is feasible to find and remove the appendix, it should be done. If, however, it means an extensive and difficult search with great risk of soiling the peritoneal cavity, it is wiser not to undertake it but to be content with the evacuation and drainage of the abscess. In that case, a large drainage tube is inserted into the abscess after it has been emptied, the parts are cleaned up, gauze packing is arranged around the tube where it passes through the healthy peritoneal cavity, the protective packing is

removed, and part of the wound is sewn up by through-and-through stitches.

If the abscess is adherent to the abdominal wall, it may not be necessary to open the general peritoneal cavity, and when the deeper layer of muscles is reached, they may be found to be yellow and infiltrated, and the separate bundles and layers cannot be defined. A fine dissector should therefore be employed to tear through the remaining tissues until the pus begins to escape. When the greater part of the contents of the abscess has been evacuated, the opening is enlarged and the finger inserted to see if the appendix can be felt. If it can, it may possibly be removed, if not, a large drainage tube is inserted and the case is treated like an ordinary abscess. To break down the adhesions and search for the appendix would subject the patient to unnecessary risk.

In some cases the abscess forms in the pelvis and fills up the recto-vesical or Douglas's pouch, but does not come in contact with the anterior abdominal wall. In the female it is quite possible to make an incision through the upper and back part of the vagina, pass a pair of sinus forceps into the abscess cavity, dilate the opening, and put in a drainage tube ; when this can be done there is no necessity for an incision in front. Similiarly, when the abscess bulges into the rectum in the male, some surgeons make an incision into the rectum and allow the pus to escape in that way. Here the drainage may be unsatisfactory, unless a drainage tube is employed and, on the whole, we think that in the majority of cases it is better to open the abscess from the front.

In all cases in which the appendix is not removed at the time it is well to perform appendicectomy at a later period. The former teaching, that the appendix might be looked on as destroyed if an abscess developed, has proved to be fallacious, and in most cases the patient is still liable to attacks of appendicitis. Hence the rule should be to remove the appendix subsequently. If possible it is well to wait a considerable time (six months to a year), because as time goes on many of the adhesions disappear and the removal of the appendix is a much easier operation than if it were done soon after the acute attack. But if the patient should begin to suffer from pain and inflammation in that region, no such delay is advisable.

COMPLICATIONS AND SEQUELÆ, AND THEIR TREATMENT.

General peritonitis. — If peritonitis is not present at the time of the operation, it very rarely arises subsequently, provided that the methods of operating and draining the wound described above are rigidly adhered to, and it should only be diagnosed when the symptoms are conclusive ; these symptoms and their treatment are described in Chap. XXVIII.

Paralytic distension of the gut.—There is usually a certain amount of abdominal distension in these cases as the result of the inflammation

of the bowel and this gives rise to a good deal of discomfort, but as a rule it passes off in the course of from two to four days. In some cases, however, it persists, and the abdomen becomes enormously blown up. There may be a good deal of pain, and the patient's general condition may become critical; vomiting may set in, and there may be almost complete obstruction.

It is not always easy to diagnose this condition from general septic peritonitis on the one hand and from a kink on the other. In distinguishing it from peritonitis the surgeon must be guided to a considerable extent by what took place at the operation. If the operation went smoothly and the appendix was removed without extensive soiling of the intestine and if a large opening was left with thorough drainage, general peritonitis can usually be excluded. If, however, a large quantity of the intestines protruded into the wound and became soiled with pus, or if no packing was introduced afterwards, general peritonitis may have occurred; in that case, however, the peritonitis sets in at once, while paralytic distension does not usually arise until the third or fourth day. The presence of a kink is more difficult to diagnose, but when it occurs there is more pain, and vomiting sets in earlier than in the paralytic condition; the obstruction is generally complete from the first. It is very important to diagnose these conditions because peritonitis and a kink both require early operation, while operation should be delayed in cases of paralytic distension because manipulation of the bowels usually makes matters worse and may prevent the recovery of the patient.

Treatment.—An attempt should be made to relieve the distension by copious turpentine or other antispasmodic enemata (see p. 211), repeated at intervals of four to six hours, and to stimulate the peristalsis of the bowel by injections of pituitary extract or of eserin (gr. $\frac{1}{100}$, combined with gr. $\frac{1}{30}$ of strychnine every four hours). The general collapse may be combated by the free administration of stimulants and by the subcutaneous or continuous rectal infusion of saline solution. Unless the patient is going to die, no operation should be performed, but if the abdomen has been opened either on account of the state of the patient or under the diagnosis of mechanical obstruction, the distended bowel should be opened and evacuated as completely as possible in the manner described on p. 342, the parts chosen for the incision, being either the cæcum (if possible) or some coil low down in the small intestine. If the patient's condition is very bad, it may be well to tie in a tube and make a fæcal fistula for a few days; if this is not necessary, one to two ounces of a strong solution of magnesium sulphate (1 in 4) may be introduced into the bowel and the opening closed at once.

Acute intestinal obstruction.—As the acute inflammation becomes localised, the coils of small intestine must of necessity become adherent. These adhesions usually cause no trouble, but occasionally they produce an acute kink of the bowel and consequent obstruction. In some cases

this passes off and all that is noticed subsequently is that there is a little difficulty in getting the bowels to act; in others, it persists and ends fatally unless promptly remedied. The symptoms do not differ from those described in Chap. XXII. If the bowels become completely obstructed after an operation for suppurative appendicitis and the patient becomes distended and begins to vomit, it may be assumed that a kink is present.

Treatment.—It is usually better to make a separate incision in the middle line in order to deal with this condition. Before doing this, the original wound should be packed and carefully covered up with a piece of gauze, wet with 1 in 2000 perchloride solution; a piece of mackintosh should be applied over it, its inner border being stitched to the skin external to the proposed site of the fresh incision. The distended bowel is sought for and traced down to the point at which it is adherent. Sometimes it is possible to detach this without breaking into the infected area; in other cases this will not be possible, and it is then advisable not to attempt to detach it, but either to perform a lateral anastomosis, short-circuiting the kink, or to open the bowel above it. These procedures are carried out in the manner described in Chap. XXII. When an anastomosis is performed, the second wound can usually be closed throughout the greater part of its extent, but if any detachment of the kink has taken place it may be safer to put in a drainage tube, and to sew up the rest of the wound with through-and-through sutures so as to minimise the effect of a subsequent sepsis. If the patient is in a very bad condition when the operation is performed, and especially if the distension has lasted for some time, the anastomosis will probably not act properly, and the only thing to be done is to bring forward a coil of intestine above the kink, open it, introduce a Paul's tube and establish a temporary fæcal fistula. This can be closed after recovery has taken place (see Chap. XXXI.).

Residual abscess.—In some cases the symptoms continue after the operation, and this is often due to the presence of another abscess. In other cases an increase of the symptoms is observed after the temperature and pulse have settled almost to normal, and a careful search should then be made for an abscess. This may be merely a loculus of pus in the neighbourhood of the operation wound, into which it ultimately ruptures, or there may be an abscess in the pelvis or beneath the diaphragm. The directions in which the pus may spread are referred to on p. 403. These abscesses may be completely shut off from the original wound or they may communicate with it by a narrow canal. In the latter case the discharge of pus is often profuse and the surgeon may be led to think that the symptoms are due to general septic absorption rather than to a localised abscess, the discharge being so copious that it is difficult to realise that sufficient drainage has not been obtained. It must be borne in mind, however, that a badly drained

abscess goes on suppurating, while it soon ceases to produce pus if it is drained efficiently.

Pelvic abscess.—It is sometimes possible to open these by insinuating a finger along the wall of the pelvis from the original wound, but when the abscess is of considerable size, it is generally better to open the abdomen in the middle line, with the precautions mentioned on p. 424, and then to break through into the abscess cavity after carefully packing off the intestines, wipe out the pus and establish drainage, either through the anterior abdominal wall or through the posterior fornix of the vagina in the female. When possible, it is well to pass a tube down through the vagina even though the abscess has been opened from the front; a tube and packing must also be introduced into the anterior opening, but this can be rapidly shortened and removed, the drainage of the abscess being carried on by the vaginal tube. The question of drainage into the rectum is referred to on p. 430.

Subphrenic abscess.—The pus may occasionally travel upwards, and form a subphrenic abscess. A subphrenic abscess resulting from appendicitis may occur in various ways. The pus may track up behind the peritoneum and the ascending colon and collect in the cellular tissue beneath the diaphragm; this is most likely to occur when suppuration has occurred behind the cæcum and has infected the cellular tissue. The abscess so formed may point in the lumbar region or it may penetrate the diaphragm and pass into the pleural cavity, giving rise to a localised empyema; the latter complication is, however, rare.

In other cases when the tip of the appendix lies in front of the ascending colon near the liver, the pus may form in that situation, and either form a local abscess there or spread up between the liver and the diaphragm and form a subphrenic abscess; the latter may penetrate the diaphragm and lead to a localised empyema, or the lower lobe of the lung may become adherent to the upper surface of the diaphragm and the pus may be evacuated through the bronchi.

In other cases these subphrenic abscesses apparently form as the result of infection through the lymphatic vessels and there may be no direct connection between the abscess beneath the diaphragm and the inflammatory focus around the appendix.

The size of the abscess and the rapidity with which the symptoms supervene vary very much; the trouble may not appear until a considerable time has elapsed since the commencement of the appendicitis.

The *symptoms* are pain in the upper part of the abdomen, increase in the liver dullness, friction sounds over the hepatic region, tenderness, and high temperature.

When the abscess is foul, gas may occasionally be present and may diminish the liver dullness. Diaphragmatic breathing is absent, but unless the pus penetrates the diaphragm, there are no physical signs of pleuritic effusion. The liver is pushed downwards, there is no

displacement of the heart, and the condition is fairly easily diagnosed from pleural effusion, but is often confounded with a liver abscess. A simple liver abscess is, however, rare in connection with appendicitis, and if it is present, rigors and sweating are common. An X-ray photograph or an examination with the fluorescent screen will often show a bulging upwards of the diaphragm on the right side and arrest of movement of the muscle.

Treatment of a subphrenic abscess.—When the pus has tracked up behind the ascending colon the abscess may be opened by an incision in the lumbar region below the twelfth rib. When an abscess has formed in front of or on the inner side of the colon, it is opened there and the cavity under the diaphragm may be drained through the same incision.

In most cases an attempt should be made to reach the abscess by an incision below the ribs, the peritoneal cavity being packed off and the operation conducted in the same manner as in opening an appendicular abscess through the healthy peritoneal cavity.

The abscess may also be opened by taking out a portion of the tenth, or possibly of the ninth and tenth ribs, in the mid-axillary line so as to get at it below the pleura. If it become necessary to open the pleura, the parietal layer should be stitched with catgut to the diaphragmatic layer all round before incising the abscess, and the proposed opening carefully packed off with gauze. The diaphragm is then incised and the opening dilated with forceps, until it is large enough to allow the introduction of a drainage tube (No. 24), which is usually firmly grasped by the diaphragm. A little gauze packing is left around the tube for the first twenty-four hours so as to shut off the pleura. Should a localised empyema occur from infection, it may be opened and drained either through the same opening or by a separate incision. When possible, the incision through the thoracic wall should be avoided on account of the risk of producing an empyema.

Thrombosis. — This occurs after appendicitis, as after many other conditions, and emboli may be carried to the lungs. Thrombosis of the femoral vein—on the left side, usually—may also be met with, but this is not more common in this disease than in any other. A form of thrombosis which is not uncommon, however, in appendicitis is septic *pylephlebitis*, leading to the formation of numerous small abscesses in the liver. The symptoms are those of pyæmia, *e.g.* rigors, high and irregular temperature, quick pulse, and tenderness, and sometimes enlargement of the liver. Unfortunately no treatment is of any avail in these cases.

Septic infections.—The patient is not only liable to general septic diseases (septicæmia and pyæmia), but also to localised infections, such as gangrene of the wound or cellulitis of the abdominal wall. These must be treated on the lines laid down in Vol. I.

Pneumonia.—The possibility of this should always be borne in mind when the patient is not doing well. It may occur as the result of septic emboli carried from veins in the region of the wound, and the

sputum often contains *Bacillus coli*. Vaccines of the organism and the general treatment of pneumonia should be employed. Ordinary pneumonia not due to septic emboli is also not very uncommon and must be treated on the usual lines.

Fæcal fistula.—This is not uncommon after bad cases, especially of gangrenous appendicitis, and generally occurs in the cæcum about the root of the appendix. It appears usually about the fifth or sixth day after the operation. It is generally due to sloughing taking place about the attachment of the appendix, and there is usually quite a small hole. With the view of avoiding this complication no pains should be spared in trying to bury the stump; but in gangrenous appendicitis, there is often a good deal of sloughing about the wound and the sutures employed to bury the stump may cut out.

Treatment.—The occurrence of a fistula naturally delays healing considerably, but as a rule the fistula closes completely as the wound contracts. All that is necessary in most cases is to keep the wound clean, to see that the drainage is good, and that the cavity closes from the bottom. As the granulations contract, the sinus gradually closes and stops the communication with the bowel. In some cases, indeed, the closure occurs more rapidly owing to other structures (bowel or omentum) falling over the orifice and becoming adherent. With the view of favouring this the tube should be shortened somewhat so that the end does not prevent this from occurring. The patient need not necessarily be confined to bed on account of the fistula; indeed, healing sometimes occurs more rapidly after he is allowed to get about. Sometimes the wound breaks down after healing, and the fistula is re-established. This means that a cavity had been left in the neighbourhood of the opening, but the insertion of a fresh drainage tube will usually lead to healing. If, however, the opening is large, it may not heal and then ultimately operation will be necessary. As a rule plastic operations fail, and it is best to make a fresh incision nearer the middle line after taking precautions to prevent soiling (see p. 424), isolate the bowel and either sew up the opening by a double layer of sutures or else excise the portion of gut and unite the ends by lateral anastomosis.

Persistent sinus.—A sinus sometimes remains for a very long time and may be due to various causes. It is specially likely to occur when the septic cavity has been drained without removal of the appendix, but when the appendix has been taken away the presence of a concretion, a portion of gangrenous appendix, or a septic ligature may keep it open. Another cause is a communication with the bowel (*vide supra*).

Treatment.—The first essential is to make certain that the drainage is efficient and that no foreign body is present. From time to time it will be necessary to dilate the external opening because it is very apt to close too soon. On no account must plugs of gauze be stuffed into the sinus—they only prevent healing; the drainage must be by a tube. If

the sinus shows no sign of healing after three months, the externa opening may be dilated very cautiously by a laminaria tent (because there are often comparatively few adhesions around it), and the cavity searched for a foreign body with a probe, a pair of forceps, or (if large enough) with the finger; a small scoop may also be introduced and the cavity gently cleared out. A large drainage tube is then introduced and the wound is dressed daily. It is very important not to be impatient in these cases. As long as the discharge is slight, there is always a probability of healing taking place, and we have seen these sinuses heal after two or three years. If, however, there are recurrent attacks of inflammation and accumulation of pus, there is nothing for it but to open up the sinus, even though that involves opening the peritoneal cavity. Indeed, in most cases it is best to open the peritoneum, pack off the intestines, and expose the bowel and the lower end of the sinus, and open up the sinus thoroughly. The wound must be packed and drained after such an operation just as after removal of an appendix in the acute stage (see p. 426).

If the appendix has not been removed, the probability of healing of the sinus without further operation is not good, and the question of removing the appendix in spite of the presence of a septic sinus must be considered. As a matter of experience it is found that there is no great risk in removing the appendix with proper precautions unless there is free suppuration from the sinus. When there is free suppuration, virulent pyogenic cocci are present, but in many cases of persistent sinus there is only a slight serous discharge which is probably only feebly infective.

The best way of performing the operation is not to open up the sinus, but to make an independent incision. The sinus should be gently scraped first of all and packed with a little gauze, partly to define it and partly to prevent any septic material from running out into the wound. A separate incision is then made in the immediate vicinity to open the general peritoneal cavity and get at the appendix from within. The amount of adhesions met with will of course vary very much, and the surgeon must work from the cæcum and the ileo-cæcal valve to the appendix itself which will usually form part of the wall of the sinus. If it is firmly adherent, the simplest plan is to expose the root of the appendix and divide the peritoneum over it, and then gradually separate the peritoneum from the appendix, ligature the latter at the base, cut it off and bury it. This avoids all risk of injuring the intestine, and it is of course the mucous membrane which gives rise to the trouble in healing. If the appendix is not very adherent, it may be separated and removed in the ordinary way. The sinus is now thoroughly cleared out and the abdominal incision is extended into the orifice, which is then packed with gauze, after which the upper part of the wound is closed with stitches. In the course of twenty-four hours the peritoneal cavity is well shut off, the gauze packing is removed, and there is usually no delay in healing.

CHAPTER XXVII.

THE 'ACUTE ABDOMEN' AND ITS TREATMENT.

By the term 'the acute abdomen' is meant a condition in which a patient is suddenly seized with severe symptoms pointing to some abdominal lesion, the most prominent being pain in the abdomen, vomiting, and collapse. These symptoms vary in intensity in different conditions, and may be combined with others which help the surgeon to come to a decision as to the nature of the trouble, but it is often extremely difficult to make an accurate diagnosis at an early stage. Nevertheless, it is most important to do so, because in many cases the only thing that can save the patient's life is immediate operative interference. And, further, as operation in these cases often adds to the collapse, it is highly desirable that as much as possible concerning the situation and nature of the trouble should be known beforehand so as to shorten the length of the operation and avoid unnecessary manipulation of the abdominal contents. We may therefore summarise the chief points, many of which have already been referred to in detail.

Many conditions may give rise to these symptoms; the following may be mentioned. They may occur in connection with a calculus in the kidney or ureter, displacement of a movable kidney, or intermittent hydronephrosis; they may also occur in cases of gall-stones or pancreatic calculi. In twists of structures, such as the ovary, ovarian tumours, or a retained testicle, similar symptoms may arise. The trouble may be connected with the intestinal tract, for example, simple intestinal colic, strangulated hernia (external or internal), strangulation by bands, intussusception, or obstruction by foreign bodies or tumours. Again, the symptoms may accompany rupture of the stomach, intestine, appendix, gall-bladder, or Fallopian tubes (extra-uterine pregnancy), or of ovarian, hydatid, or pancreatic cysts. They may be due to irritant poisoning, or to an inflammatory condition, such as appendicitis, or inflammation of Meckel's diverticulum, or of the appendices epiploicæ, or uterine appendages. Peritonitis (septic, pneumococcal, or tuberculous), or acute pancreatitis, gastritis, enteritis, colitis, abscess in the abdomen or liver,

pylephlebitis, or peri-renal abscess, may be found to be the cause. The symptoms may, however, not be due to trouble in the abdomen, but in the thorax; thus pneumonia or pleurisy sometimes begins with vomiting, epigastric pain and tenderness, and symptoms resembling subphrenic abscess.

It may be useful if we consider the significance of the chief symptoms which arise, and the indications for immediate operation. The symptoms may differ according as they are observed at the commencement of the trouble or at a later period.

Significance of the chief early symptoms.—*Pain.*—The character and situation of the pain are of importance. In perforations of the stomach, intestine, or gall-bladder, the pain is severe, constant, and of a burning character. At first it is limited to the seat of rupture, though it soon spreads over the abdomen. In rupture of cysts, the pain is more diffuse from the first and not so severe, but it is most marked over the seat of rupture. In perforation of the appendix the severity of the pain varies much, but it may be severe and located in the appendix region; usually, however, the fixed pain in that region is associated with, or preceded by, colicky pains in the neighbourhood of the umbilicus. In other cases appendicitis commences with colicky pains at or above the umbilicus, and pain in the appendix region develops later. In internal strangulations, and other obstructive conditions, there may be pain at the site of the lesion, but the chief complaint is severe recurring colic referred to the umbilical region. Gall-stone pain is epigastric, passing through to the back and shoulder, and very severe. Renal or ureteral pain is severe and somewhat spasmodic, and shoots downwards to the scrotum and inner side of the thigh.

Tenderness is not present in all cases of abdominal pain, and may differ according as the examination is made by pressure or percussion. It is marked from the first in cases of inflammation or rupture of a viscus, and is generally greater on percussion than on pressure. In cases of obstruction, on the other hand, the pain may be relieved by pressure; this may also be the case in biliary or renal colic. In some cases the whole abdomen may be tender, but the seat of the lesion is generally indicated by an area of extra tenderness. Unless general peritonitis sets in, the tenderness diminishes as time goes on, except over the seat of the disease, where it increases.

Abdominal rigidity is a very prominent symptom in many of these conditions. It is most marked over the seat of the disease and may be limited to it, but in the early stage of rupture or inflammation it is general over the abdomen. In localised inflammations it—like the tenderness—diminishes, except over the area of the disease. In bad cases of peritonitis gives place to distension of the abdomen; if the abdomen remains rigid all over, it points to rupture of a viscus, or the early stage of general peritonitis or strangulation.

Vomiting is present in a number of abdominal cases, and is not at first of any important diagnostic value. It occurs early in rupture of the stomach, and is also one of the early symptoms in appendicitis or in strangulations. It is the persistence of the vomiting which is of importance, as this points strongly to some mechanical obstruction; temporary vomiting is usually only an early and reflex effect, which passes off very soon. The character of the vomited materials may also be a guide: for example, fæculent vomiting usually means obstruction, while the presence of blood suggests ulcer of the stomach.

Collapse is strongly suggestive of rupture of a viscus, of an internal strangulation, or of hæmorrhage, and may be very marked in these cases. Its degree depends to a great extent on the severity of the case, and (in cases of rupture of a viscus, more especially) on the suddenness and amount of the extravasation. A slight leak, gradually increasing—as in an old ulcer of the stomach—will not have the same effect as a sudden and free escape of the contents of the stomach or bowel into a previously healthy peritoneal cavity. In internal strangulation also, the amount of collapse depends on the suddenness and tightness of the strangulation. On the other hand, collapse is absent or only slightly marked in inflammatory affections. If it is present along with other symptoms pointing to appendicitis, it indicates either perforation or gangrene of the appendix. The presence of collapse is a strong indication for operative interference, although in some cases it may be advisable to wait for two or three hours to allow the collapse to pass off to some extent—unless indeed the collapse is due to hæmorrhage.

Rigor.—The occurrence of a rigor generally indicates some inflammatory condition and not infrequently ushers in an attack of acute suppurative appendicitis.

Pulse.—Increase in the pulse-rate is common in all these cases, and may set in almost at once in perforations and other grave conditions. It usually rises more slowly in inflammatory affections, in which an early and marked rise in the pulse-rate is a very bad sign: a rate of 120 or over is serious and is in favour of immediate surgical intervention. The character of the pulse is also of great importance; a small, running, and irregular pulse is a very bad sign, and no time must be lost if operation seems otherwise desirable.

Pyrexia.—Elevation of temperature in the early stage implies inflammations rather than strangulations, herniæ, or twists; but even in inflammatory affections the temperature may not have risen when the patient is first seen, and in perforations it may be subnormal. If, therefore, the temperature is found to be raised in a case beginning with the usual symptoms of peritonism[1] and seen early, the affection in all probability is

[1] The term 'peritonism' is usually employed to denote a condition of general irritation of the peritoneum, as often occurs in the cases we are speaking of here, as opposed to a general inflammatory condition or 'peritonitis.'

due to some inflammatory condition—such as peritonitis, appendicitis, cholecystitis, or salpingitis ; if the temperature rises soon after being depressed at first, there is usually some perforation. The temperature is not elevated in internal strangulation unless gangrene or peritonitis sets in. The question of the temperature, however, is to some extent of secondary importance, and must be weighed with the other symptoms. It may be elevated in other conditions—for example, in some cases of renal calculus—and it may also rise unduly high in patients who have had malaria.

The presence of *free gas* in the abdomen, as indicated by obliteration of the liver dullness while the abdomen is still retracted and rigid, or at any rate not distended, is a sign of perforation of the alimentary canal. This should also be borne in mind in operating, and if gas escapes on opening the peritoneum, attention must always be directed to the stomach or intestinal tract and the perforation searched for.

The *general aspect of the patient* is usually a good indication of the gravity of the condition. In internal strangulation or rupture of the stomach, the patient is pale, with the typical abdominal face, and lies on his back with his knees drawn up. In appendicitis with perforation the patient does not feel very ill at first, but becomes worse later ; in gangrenous appendicitis he is ill from an early stage. In gall-stones or renal calculi, the patient is restless, doubled up, presses on his abdomen, and does not have the typical greyish abdominal face.

Some assistance may also be obtained from the *previous history*. Thus, there may be a history of indigestion and epigastric pain after food, or of hæmatemesis, indicating an ulcer of the stomach, or of previous attacks of appendicitis, or of renal or biliary colic. Such a history may be of great assistance, but the absence of it does not preclude these affections, for it may be a first attack. A history of old peritonitis may strengthen the diagnosis when the symptoms point to internal strangulation. The history of events preceding the attack is of importance—such as diarrhœa, constipation, violent exertion, or a large meal. Malaise, preceding the acute onset, usually indicates an inflammatory attack—such as appendicitis—rather than a sudden strangulation ; premonitory symptoms—such as dyspepsia—may also appear in gall-stone colic.

Significance of symptoms arising later.—These early symptoms alter, and other symptoms appear as time goes on and may aid the diagnosis and determine the question of surgical interference. For example, the *spreading of the pain and tenderness over the abdomen* indicates a grave lesion and the development of general peritonitis, while the localisation of the pain to one spot or region indicates a shutting off of the inflammatory action and a much more favourable condition.

Persistence of colicky pains is another important indication ; if they persist, the probability of strangulation is increased, whereas in appendicitis, for example, though colic may be very marked at the beginning

it soon subsides, and the pain and tenderness become located in the appendix region.

Continuance or subsidence of the vomiting are also of importance. Persistence of the vomiting usually indicates intestinal obstruction, and the materials vomited eventually become fæculent. On the other hand, while vomiting is one of the earliest symptoms in perforation of the appendix, and may continue for a few hours, it ceases after a time. Should it recur, it generally indicates a grave septic condition, as in later stages of acute peritonitis.

Persistence or deepening of the collapse indicates an extremely grave perforation or some hæmorrhagic condition, such as ruptured tubal fœtation or hæmorrhagic pancreatitis. In other cases, as a rule, the initial collapse is followed by marked reaction.

Information may be obtained from the *continuance or location of abdominal rigidity.* Continuance or increase of general rigidity implies a diffuse process—usually general peritonitis—while relaxation of the contraction over the greater part of the abdomen, and rigidity only in one area, indicates a more or less local lesion—generally some inflammatory condition.

Elevation of temperature, whether from the first or coming on within the first few hours after the seizure, is strongly indicative of an inflammatory condition—such as appendicitis or cholecystitis ; while continuance of a normal temperature points more to some mechanical condition. In some cases of appendicitis, however, no marked rise in temperature may occur for some time. *Fall of temperature* after previous elevation is usually a bad sign if the other symptoms continue, and indicates profound toxæmia.

Increasing rapidity and weakness of the pulse and a tendency for it to 'run,' are symptoms of gravity, and, occurring during the first day, generally indicate some grave septic lesion—such as perforative or gangrenous processes.

Distension of the abdomen.—In most of the serious abdominal cases the abdomen becomes distended. Early distension usually indicates either a general peritonitis and paralytic distension of the bowel or else intestinal obstruction. According as we gather from the other signs that we have to do with an inflammatory or a mechanical process, this is a sign of greater or less gravity. In obstruction, the greater distension of one part of the abdomen and the consequent differences in the abdominal contour may be of considerable value as indicating the site of the obstruction.

The state of the bowels is not of much help in the diagnosis. In mechanical obstruction there is complete cessation of the passage of fæces and gas ; but if the bowel below the obstruction is loaded at the time of onset of the mischief there may be one or two actions in the early stage, either alone or after enemata, and this may cause

confusion. Inflammatory conditions, such as appendicitis, although at first perhaps accompanied by diarrhœa, are also usually marked by complete arrest of the passage of fæces and gas, but even then it is often possible to get away some gas with a long tube or with enemata.

The character of the tongue is also of importance. In bad septic conditions—such as gangrenous appendicitis or general peritonitis—the tongue becomes brown and dry, while in obstruction it remains white and moist until near the end.

Diagnosis.—The symptoms often overlap very much, and there are so many exceptional conditions that an accurate diagnosis may be impossible, especially in the early stage when, from the point of view of surgical treatment, it is most important. The presence or absence of symptoms indicating involvement of particular organs will help in the diagnosis.

Take for example, acute affections in connection with the kidney. Renal and ureteral colic are very typical. The excruciating paroxysms of pain, not limited to the back but shooting down into the thigh and testicle, frequent and scanty micturition, blood in the urine, and the absence of intestinal colic and abdominal rigidity, are sufficiently characteristic. But even in renal colic the symptoms may not be nearly so acute or typical, and the difficulty of distinguishing between appendicitis and renal or ureteral colic, when the symptoms are not severe, is sometimes considerable, and mistakes in diagnosis have been repeatedly made; we need not, however, go into this subject here, because we are only dealing with cases of the most acute type. The condition of intermittent hydronephrosis is also sometimes confusing. Here the urine becomes temporarily dammed back and the pelvis of the kidney swells up rapidly; the patient is usually seized with severe pain and vomiting, but the pain is definitely located in the loin and side; colicky pains are absent, there is tenderness, and a distinct swelling may often be detected, which is much larger and better defined and develops much earlier than that in appendicitis or cholecystitis; there is no elevation of temperature. Other acute renal conditions—such as peri-renal abscess—may also cause some difficulty, but are generally fairly easily recognised by the position of the pain and the absence of signs pointing to other possible conditions. Abscess forming after duodenal rupture is probably the most difficult condition to distinguish from peri-renal abscess in the later stages.

Gall-stone colic is also fairly definite, the violent epigastric pain shooting through to the back and shoulders, doubling the patient up and relieved by pressure, and the absence of pyrexia, being generally very characteristic. It is in the less acute cases that the difficulty arises.

When the alimentary canal is apparently involved, an important point is whether the lesion is of inflammatory or non-inflammatory origin.

An initial rigor, rising temperature, marked tenderness—especially on percussion—and the other cardinal symptoms of inflammation will often be sufficiently distinctive; and then, in addition, the disappearance of the initial colicky pains and the occurrence of a steady pain in one part, increased on movement or taking a deep breath, and the subsidence of the vomiting, contrast markedly with the condition in intestinal obstruction. If pyrexia or other signs of inflammation do not develop, attention must be directed to any possible cause of obstruction, especially if vomiting persists or if severe colicky pains continue. If, however, the patient, although presenting no signs of inflammation in the earliest stages, develops these later on, it arouses a suspicion that there is some perforation of the alimentary tract—for example, of the appendix. Perforations of the stomach or duodenum may be indicated by the suddenness and intensity of the pain, which is fixed and steady rather than colicky (although the latter may also occur), of a burning character, and tends to spread over the abdomen, and by the severity of the collapse, distension of the abdomen, elevation of temperature, and signs of peritonitis. Obliteration of the liver dullness with retraction of the abdomen, due to the presence of free gas in the peritoneal cavity, is also a very important sign.

Treatment.—The next question that arises is: Is the case one requiring immediate surgical treatment or not? It may not be possible to answer this question definitely at the first visit, but if it is not, frequent visits should be made until a definite decision has been arrived at.

All perforations of the alimentary canal, strangulations, internal herniæ, gangrenous processes and hæmorrhages should be operated on without delay. The chief difficulty as to immediate operation is in connection with the various inflammatory conditions of which appendicitis is a type; this subject is dealt with in Chap. XXVI.

CHAPTER XXVIII.

PERITONITIS: PERITONEAL CYSTS: ASCITES.

INFLAMMATION of the peritoneum may be acute or chronic. The acute forms are usually associated with infection of the peritoneal cavity by pyogenic organisms, and practically always end in suppuration which may be diffuse or localised. The chronic forms may occur in connection with tuberculosis, ulcers of the intestine, echinococcus cysts, diverticula from the bowel, new growths, and so forth.

LOCALISED SUPPURATIVE PERITONITIS.

We have already considered local peritoneal suppuration in speaking of appendicitis, diverticulitis, and ulcer of the stomach and duodenum. It may also occur in connection with infections of the gall-bladder, the Fallopian tubes, and other parts; these conditions are considered under their respective headings. As a rule the perforation of a hollow viscus into a healthy peritoneal cavity leads to a general diffuse peritonitis without any localisation; when it is localised there has usually been a previous plastic peritonitis, which has led to adhesions around the point of perforation. The perforation then takes place into the midst of these adhesions, and a localised abscess may result either around the seat of perforation or in the neighbourhood, or at some distance away by extension of the infection along the lymphatics, as in subphrenic abscess after appendicitis.

GENERAL SUPPURATIVE PERITONITIS.

From the point of view of treatment, this is one of the most terrible and most disheartening conditions that can be met with. It usually arises in connection with perforation of a viscus such as the stomach, the intestine, or the appendix. It may follow rupture of a localised collection of pus in the Fallopian tubes or elsewhere, perforation of a septic gall-bladder, or extravasation of septic urine; it may follow

operations in which septic material has been introduced, or it may occur without any definite local abdominal lesion, in which case it is usually due to the pneumococcus.

The characters and treatment of this condition have already come up for discussion in connection with various conditions such as rupture of the stomach and intestines, and acute appendicitis ; it may be well here to make a few remarks on the form due to the pneumococcus.

PNEUMOCOCCAL PERITONITIS.

The occurrence of pneumococcal infection of the peritoneum has been variously explained, one view being that the organism is introduced through the alimentary canal or the genital passages, while another is that the disease is primarily a septicæmia which produces a local lesion in the peritoneal cavity, the original point of entry of the organisms being the respiratory tract. In about 50 per cent. of cases an affection of the lungs or pleura is present as well, the two affections being either concurrent or the peritonitis following the pneumonia.

The disease usually commences as a generalised infection of the whole peritoneal cavity, but in favourable cases it may become localised and a limited abscess may form, usually situated in the pelvis or around the cæcum. In the diffuse cases, as in all other forms of acute generalised peritonitis, the prognosis is extremely grave, but in the localised type it is more hopeful.

It is most commonly found in children, and there is a definite preponderance in the female sex, which is more marked as the age increases. The organism is usually found in pure culture, but a mixed infection with the streptococcus pyogenes may occur, although it is possible that in some cases the organisms described as streptococci may have been merely atypical pneumococci.

In the early stages of the disease the symptoms are diffuse over the abdomen. There is tenderness and rigidity, which, however, may be absent in infants, and there is evidence of general absorption. Diarrhœa with foul stools is a fairly constant symptom, and, in consequence, the distension of the abdomen which is so characteristic of peritonitis is not marked. At first the abdomen is retracted, but later on it may become slightly fuller owing to the presence of exudation, and occasionally tumours composed of thickened and matted omentum may be palpable. The exudate is similar to that found in other pneumococcal infections, that is to say, it is inodorous, greenish and flocculent, and it may vary from a sero-purulent fluid to thick pus with large flakes in it. In a severe case the symptoms are intense, and the patient passes rapidly into the typhoid state and dies ; in the milder forms complete resolution or the formation of a localised abscess may occur, or the disease may become subacute with or without the formation of localised abscesses.

Even when they are not treated promptly, the patients may live for several weeks, which is quite a different course from that of acute septic peritonitis. The prognosis in these cases is correspondingly more favourable.

TREATMENT.—This should be on the lines suggested for general peritonitis or for a localised abscess. The peritoneum should be opened through the rectus, and the fluid and flakes allowed to flow out. The peritoneal cavity may then be gently irrigated and the loose flakes evacuated, and drainage tubes may be placed in the flanks and down into the pelvis. Vaccine therapy may also be employed, but must be used with great care, because cases have occurred which were going on well after operation, and in which, after a dose of vaccine (possibly too large) the course has changed for the worse and death has occurred.

GONOCOCCAL PERITONITIS.

This is most frequent in females in whom the infection occurs through the Fallopian tubes ; it usually remains limited to the pelvis, but may become generalised. While pus is often present in the tubes, suppuration may not occur in the peritoneal cavity, and in some cases the condition may subside without leaving many adhesions. It often begins very acutely, but in a day or two may become subacute or chronic, exacerbations taking place from time to time or complete recovery occurring. The questions of recovery and of the necessity for operation depend mainly on whether pus is present in the Fallopian tubes or not. This is indicated by feeling a swollen or painful tube or tubes *per vaginam* and by the presence of a purulent vaginal discharge, especially if it contains gonococci. When these conditions are present the abdomen should be opened, the Fallopian tube or tubes removed, and, if necessary, drainage of the pelvis provided by perforating the roof of the vagina in the middle line behind the uterus and passing a drainage tube into the vagina ; the anterior wound can then be closed.

CHRONIC TUBERCULOUS PERITONITIS.

Tuberculosis is the most common cause of chronic peritonitis. It is usually secondary to tuberculous ulceration of the intestine or tuberculous mesenteric glands. It may also follow tuberculous disease of the female genital organs (especially the Fallopian tubes) and sometimes, though much more rarely, of the vesiculæ seminales in the male. It may occur in connection with a tuberculous pleurisy. Primary tuberculosis of the peritoneum is comparatively rare.

Tuberculous disease of the intestine is said to occur most commonly in the lower part of the ileum, but it is also frequent in the cæcum ; in some cases it may commence in the vermiform appendix.

Many authors look upon tuberculous intestinal ulceration as the most common causes of tuberculous peritonitis. The tubercles forming the base of the intestinal ulcer gradually infiltrate the wall of the bowel until they reach the sub-serous coat, and then rapid infection of the peritoneum follows, at first local but soon becoming general. The form associated with intestinal ulceration is usually extremely serious. Perforation and suppuration may occur ; the latter may be localised, and fæcal fistula is not uncommon.

When the Fallopian tubes are affected they become large, hard, and tortuous, and form sausage-shaped masses full of cheesy material or broken-down pus with their walls dotted with tubercles. The tubes usually become adherent to the uterus and intestine. The disease in the tubes almost always commences close to the fimbriated extremities, and the canal is quickly shut off from the peritoneal cavity by fibrous adhesions.

Large tuberculous mesenteric or retro-peritoneal glands are commonly present, and in some cases may have been the source of the peritoneal infection.

Varieties.—The results of tuberculous infection of the peritoneum differ widely, and the conditions found may be divided into three main groups. These groups are quite arbitrary, and there is no hard and fast line of separation between each ; they are, however, clinically important.

1. The peritoneum is studded with tubercles, some being small, greyish and transparent nodules, others large and becoming cheesy. They are scattered over the visceral and the parietal peritoneum and frequently have patches of fibrinous exudation over them ; in the early stage there is not necessarily any matting of the intestines or distortion of the omentum or mesentery. In these cases there is almost always fluid in the abdominal cavity, usually of a light straw colour, or opalescent, or blood-stained. The sensation on putting the finger into an abdomen in this stage is the same as if it were passed into a bag of sago. The tubercles generally occur in patches, and are most marked in the vicinity of the primary lesion. Although matting together of the intestines is not a feature of the disease at this early stage, they may become adherent to a certain extent, and thus the fluid in the abdomen does not pass freely from one part of the cavity to the other, and may accumulate in parts and become practically encysted.

2. In a second group, adhesions of the intestines and fibroid induration of the omentum and mesentery are the marked features. The intestines become bound together by firm fibrous tissue in which miliary tubercules are present, and these adhesions may constrict the intestine, or may cause kinking and lead to obstruction. The intestines are adherent to one another and to the abdominal wall ; this is a cause of anxiety in opening the abdomen in these cases and is the chief objection to aspira-

ting it for the removal of fluid. When the entire abdomen is affected, the adhesions are most marked near the diaphragm. The omentum is early involved ; its layers become matted together and the whole structure becomes thickened and shrunken and, in the advanced stages, forms a sausage-like mass lying more or less transversely about the level of the umbilicus. It is generally adherent to the abdominal wall at this point. The omentum contains numerous tubercles in its substance and scattered over its surface, while the mesentery is thickened and shrunken and drags the small intestine up towards its root, so that, when fluid is present, it generally collects towards the left side of the abdomen. It is seldom that any large quantity of free fluid is present in these cases, but encapsuled collections are not uncommon. The mesenteric glands are also enlarged, though not as a rule cheesy. The spleen is frequently enlarged.

3. In the third group, which is a very grave one, the masses are larger and are undergoing caseation. The mesenteric glands are large and caseous, the omentum is often converted into a caseating mass, and similar masses form in the adhesions which bind the intestines together. The contraction and distortion of the bowel, the shrinking of the mesentery and the other changes mentioned under the second form are much more marked. This condition is usually associated with ulceration of the intestine, which is thinned and may even be perforated in places, while in others several strictures (some of them quite tight) may be present and may cause more or less obstruction. Collections of fluid are not uncommon ; they are usually encapsuled and generally purulent, the pus presenting all the characters of ordinary tuberculous pus. In some cases, however, it is foul and contains the *Bacillus coli communis* either from infection through the intestinal walls or from actual perforation of the intestine. In young children these abscesses are most common near the umbilicus, through which pus may find its way and lead to the formation of a sinus or even a fæcal fistula. As the latter is often high up in the small intestine the child rapidly emaciates.

The above are the chief types of tuberculous peritonitis, but intermediate varieties are met with. The affection may be localised, especially in connection with tuberculous perityphlitis or disease of the Fallopian tubes, and the mass thus formed has frequently been mistaken for a tumour ; in the cæcal region such masses may give rise to more or less complete obstruction.

Apart from these cases the essential trouble may consist of masses of tuberculous glands in the mesentery, some calcareous and some suppurating, without any eruption of tubercles on the peritoneum. Although these cases hardly come under the heading of tuberculous peritonitis proper, it is perhaps best to include them here.

The affection may occur at any age, but it is most frequent between the ages of twenty and thirty-five ; it is common in children, but comparatively rare after thirty-five. Difference of opinion exists as to

the relative frequency in the two sexes, but, judging from the frequency with which operations are performed, females seem to be much more often affected than males.

Symptoms.—It is not easy to diagnose the disease in the early stages. It may begin insidiously, or it may be acute and spread rapidly and be mistaken for typhoid fever or general tuberculosis. The following are the chief symptoms: The patient complains of malaise, headache, and thirst, does not sleep well and suffers from night-sweats. The appetite is soon lost, and there may be occasional vomiting. The bowels are irregular and there is constipation or diarrhœa, or alternations of the two.

After a time abdominal pain occurs which is increased by exertion or it may be only a feeling of weight; it is rare for pain to be marked at the commencement of the disease. There is generally an evening rise of temperature, but in some cases there is none; in others the temperature, after being normal for a considerable time, may suddenly rise in the evenings and assume a hectic type. In all except the acute cases, the patients are able to get about in the early stages, but from time to time they have to lie up on account of general weakness or of increasing pain. After some weeks or months, however, the patient has to take to bed altogether either on account of progressive weakness or more commonly of gradual swelling of the abdomen, pain, and shortness of breath. As the disease goes on, there is a rapid increase in the malnutrition and emaciation, the skin becomes pale, sallow, and dry, the cheeks sink in, and the patient acquires the abdominal aspect.

The local conditions found on palpating the abdomen depend on the pathological changes already described and, also to a great extent, on whether fluid is present in the abdomen or not. When fluid is present, the abdominal wall is tense, with big veins running over it and the lower ribs are everted. Fluctuation is often indistinct and the fluid changes its position slowly as it makes its way among the adherent intestines. Sometimes the fluid is encapsuled and forms tumours often mistaken for ovarian or dermoid cysts, or the broken-down glands may form large abscesses. In other cases there may be little or no fluid present; the intestinal coils become adherent, the mesentery contracts, the omentum is thickened and shrunken, and hard masses are formed in the abdomen. In these cases the thickened omentum may be felt as a sausage-shaped mass running transversely across the abdomen about the level of the umbilicus. The percussion note is variable. The intestinal coils are irregularly distended with gas, there may be marked meteorism and, when there is partial obstruction, the coils may be seen through the abdominal wall. The splenic dullness may be increased, while the liver dullness is not uncommonly diminished. The stools are light in colour from imperfect digestion of fat.

The disease is often associated with various *complications*, such as

intestinal obstruction due to kinking, to bands, or to stricture following ulceration. Perforation may also occur from rupture of an ulcer, or there may be abscess formation, with discharge of pus from the umbilicus and fæcal fistula. The disease is sometimes complicated with phthisis or pleurisy.

The *diagnosis* is not always easy. The affection has to be distinguished from ulcer of the intestine, malignant disease, gastric catarrh, typhoid fever, peritoneal cancer, chronic peritonitis from other causes, and ovarian cysts. The points in favour of tuberculous peritonitis are a family history of tuberculosis, tubercle elsewhere, the presence of localised thickenings in the abdomen, a fairly rapid formation of fluid with no demonstrable cause, a feeling of weight and uneasiness, percussion note changing slowly with alterations in position, a hectic temperature (though sometimes there is little or no fever), albuminuria, and no other demonstrable cause for the ascites.

The *prognosis* is undoubtedly very grave, but much depends on the form of the disease and on the presence or absence of complications. Physicians now take a much more hopeful view of the trouble than they did and, provided that no complication such as phthisis, obstruction, or perforation arises, the outlook in the young is not now considered nearly as bad as it was formerly.

TREATMENT.—This is partly medical and partly surgical ; in the early stage the treatment lies with the physician.

Medical.—The patient should be placed under the best hygienic conditions ; tuberculin injections (see Vol. I. p. 522) should have a trial. When there is intestinal ulceration, the diet must consist entirely of fluids which should be selected for their nutritive value, such as milk and raw meat juice. The bowels should be regulated ; if ascites is present, diuretics will be called for. Cod-liver oil may be given either by the mouth or by the rectum, and arsenic is of use. Intestinal antiseptics, such as creosote, salol or guaiacol may also be employed. Dr. Burney Yeo speaks highly of abdominal inunction with iodoform ointment and the internal administration of iodoform in the form of one-grain pills three times a day. When pain is very marked, the local application of belladonna to the abdomen or a subcutaneous injection of morphine may be desirable. Open-air treatment, with complete rest in bed in the first instance at any rate, should be carried out.

Surgical.—Until comparatively recently surgical interference was not thought of unless some complication occurred, and this, to some extent, is the case even now. It has been found however, in a number of cases in which the abdomen has been opened for other reasons, that tuberculous peritonitis has been present, but that nevertheless the condition has rapidly improved after the operation, although nothing was done beyond opening the abdomen ; this has occurred so frequently that, of late years, simple laparotomy has become the chief surgical measure for cases which do not yield to medical treatment.

Surgical intervention may also be called for when there is intestinal obstruction, or a collection of purulent fluid, or with the object of extirpating a localised tuberculosis; in these last cases, however, the diagnosis is comparatively rarely made sufficiently early. Lastly, surgical intervention may be required for the cure of a fæcal fistula.

Simple laparotomy.—The results of a simple laparotomy for tuberculous peritonitis vary considerably according to the type of disease present, but all types may improve after it. The greatest improvement is obtained when there is free fluid in the abdominal cavity, but it may also occur in cases in which little or no fluid is present; even in the bad caseating cases a few, though by no means the majority, may improve. The laparotomy simply aims at opening the abdomen, and if any fluid is present it is allowed to run out.

The cases most suited for operation are those belonging to the first group, especially if the pathological changes are localised, and the next most favourable are those in which the fluid is diffused over the abdomen. In the third group the successes are few and the operation is difficult; indeed, a fæcal fistula may result even without apparent injury to the intestine. It is also not uncommon in these bad cases for the scar to become infected with tubercle; but, even in spite of this, benefit may ultimately occur, while practically all the patients in this stage die if left alone. Hence none of the classes can be quite excluded from operation, but the frequency with which operation will be resorted to differs in different cases; in those with effusion it will be often had recourse to, in others less often, and in the caseating form only as a last resort and usually on account of the presence of complications. The operation, when not accompanied by excision of portions of the abdominal contents, is not followed by shock, and the presence of phthisis does not seem to be a bar to it; indeed, the condition of the lungs has often been found to improve *pari passu* with the local condition in cases that have benefited by operation.

Most suitable time for operation. — Unless improvement follows medicinal treatment within six weeks in acute cases or six months in chronic ones, the abdomen should be opened whether fluid is present or not. The operation may do good when it is least expected to do so, and in any case the patient should not be allowed to go downhill too far before it is carried out; on the other hand, it apparently does not do to operate too soon, operation in quite the early stage often being without any effect. If the patient is suffering from incomplete obstruction, the abdomen should be opened early with the view of performing a short-circuit operation, or even, if possible, of removing the affected portion of the intestine or the primary seat of the disease.

Operation.—An opening is made in the middle line of the abdomen below the umbilicus, any fluid that is present is allowed to run out, its escape being aided by turning the patient on the side, and then the wound is stitched up again. Formerly the abdomen was washed out

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with various antiseptics such as carbolic acid or sublimate lotions, or was flushed with salt solution and carefully dried with sponges. These methods seem unnecessary, as equally good results are obtained after simple laparotomy. When adhesions are present, great care is necessary in opening the abdomen to avoid injury to the intestine and, if the adhesions are firm and numerous, it is better to close the wound rather than force a way in among the intestinal coils; the bowel is usually fragile, and any attempt to separate adherent coils may result in laceration of the intestine at the time or may so injure its wall as to lead to the formation of a fæcal fistula subsequently. When pus is found, it should be washed out by salt solution, and some iodoform and glycerine emulsion should be introduced into the abscess cavity before it is closed.

Various important points have to be considered in connection with the operation, the first of which is the question of drainage when fluid is present. There seems to be no advantage in this when the fluid is serous; indeed, it may lead to a tuberculous sinus. When pus is present, provided it is not foul or apparently infected, it is best to treat it like a chronic abscess elsewhere, washing out the cavity and leaving in a little iodoform and glycerine (see Vol. I. p. 234); if, however, the pus is infected with pyogenic organisms, drainage must be provided.

Another important question is whether the primary focus should be searched for, and removed. Much will depend on the condition of the patient and the extent of the disease in the peritoneum. Theoretically, of course, the primary focus should be removed, and practically it has been found that the best results have followed this practice in suitable cases, seen early. On the other hand, the disease is very extensive in the majority of cases to which the surgeon is called and the question becomes much more complex. As a result of what has been done in this way, we would formulate the following opinion: When the tuberculous disease is strictly localised to the neighbourhood of the primary focus—*e.g.* when only a few coils of small intestine are affected in the neighbourhood of an intestinal ulcer; when the disease is confined to the cæcum and the neighbouring parts of the ileum as is not infrequently the case; when the appendix is the primary seat of the disease; or when there is only a commencing eruption of tubercles about the Fallopian tubes without any extensive matting of the intestine, the primary focus should be removed, provided the patient's strength is good, even though it involves resection of the small intestine or of the cæcum, or removal of the appendix or of the Fallopian tubes, and the results obtained are certainly better than those of simple laparotomy. On the other hand, in the more advanced cases, adhesions are present and it is excessively difficult, in the first place, to find the primary focus and, in the second, to remove it when found. Here also the patient is generally run down and cannot stand a prolonged operation; moreover, the tuberculous intestines are so fragile that they tear readily and a fæcal

fistula or a fatal perforation may follow. We therefore recommend that in advanced cases it is better to be content with a simple laparotomy unless the primary focus is readily removable.

In some cases, when the abdomen is opened, the chief trouble is found to be in the *mesenteric glands*. These may be small and calcified, or larger and undergoing caseation, or actually forming abscesses which have not as yet burst into the peritoneal cavity. When they are small and calcareous, it is seldom necessary to interfere with them, but when they are larger and breaking down, it may be advisable to try to shell them out, taking care, on the one hand, not to injure the mesenteric vessels and, on the other, not to rupture the glands, otherwise a tuberculous peritonitis may be set up; sometimes very marked improvement may follow this procedure. When the disease is more advanced, quite a large abscess may have formed in the mesentery and may not yet have infected the peritoneal cavity. In such cases, any attempt at excision of the abscess would be very serious and might lead to extensive injury of the mesenteric vessels involving immediate resection of a portion of the bowel. On the other hand, it would be difficult to open and deal with these abscesses inside the abdomen without soiling the peritoneal cavity with tuberculous pus, and this might lead to an acute tuberculous peritonitis. In such a case we have brought forward a portion of the abscess wall to the opening in the parietal peritoneum, stitched it carefully to that opening so as completely to shut off the peritoneal cavity and then opened the abscess, evacuated the pus, and dealt with it in the usual manner (see Vol. I. p. 234).

Laparotomy for obstruction.—Another reason for surgical intervention is intestinal obstruction (see p. 449). When the abdomen has been opened, the surgeon must judge how far the condition can be remedied either by resection of the infected portion of the intestine (which, however, can only be seldom practicable) or by an anastomosis of healthy bowel above and below the seat of obstruction. Cases of recovery after a short-circuit operation done for almost complete occlusion of the intestine have come under our care and similar cases have occurred in the practice of others.[1] Therefore, in all cases in which symptoms of grave obstruction are present, the abdomen should be opened and a short-circuit operation done if possible. When this is impossible, the abdomen must be closed again in the hope that the mere laparotomy will lead to improvement.

Mr. Mayo Robson[2] has suggested that a short-circuit operation should be done in cases of tuberculous ulceration of the intestine, not only to avoid obstruction but also to give rest to the affected portion of the bowel. This is no doubt theoretically good, but practically the surgeon rarely sees the cases until the tuberculous peritonitis has

[1] See *Lancet*, January 12, 1902.

[2] See *Clinical Society's Transactions* (1902), p. 58.

lasted for some time or (in the case of intestinal tuberculosis), the gut has become narrowed and symptoms of obstruction are present; as a matter of fact, there were symptoms of commencing stricture before operation in Mr. Mayo Robson's cases. It does not seem probable that there is much of a future for short-circuit operations in intestinal tuberculosis apart from obstruction. The extent of the mischief is variable and a large portion of the alimentary canal might have to be shut out and, further, the operation will not give complete rest to the intestine unless there is marked obstruction, as a large portion of the contents will still pass through the ulcerated bowel.

Treatment of a fæcal fistula.—Here operation is practically hopeless. Suppuration followed by fæcal fistula occurs especially in the very bad caseating forms in which the intestine is not in a fit condition for repair; generally also the patient is in a very low state of health and the chances are probably equally good if he is left alone. Quite a considerable number of these fistulæ close if the condition of the patient improves.

CHRONIC NON-TUBERCULOUS PERITONITIS.

A sub-acute non-suppurative peritonitis may occur as the result of *rupture of an hydatid cyst* into the peritoneal cavity. This is often followed by symptoms of acute poisoning, probably from some toxic substance in the fluid effused, and this may be dangerous to the patient if the fluid is not evacuated; a certain amount of peritonitis is also set up, which may lead to the formation of adhesions. In these cases the sooner the peritoneum is opened, the cyst removed or drained, and the abdomen washed out with saline solution, the better.

Rupture of an ovarian cyst may lead to an attack of peritonitis which tends to fix the cyst. This is more marked if the cyst is a proliferating one, in which case villous growths quickly form over the peritoneum. In these cases the abdomen should be opened as soon as possible after the rupture, the cyst removed, and the effused fluid washed out.

A generalised chronic peritonitis also accompanies *peritoneal cancer*, which usually follows extension of a growth through the peritoneal coat of the bowel or some other viscus; it may arise, however, without any primary focus outside. Ascites rapidly develops, but there is no marked tendency to the formation of adhesions. For these cases nothing can be done except to perform paracentesis if the abdomen becomes so much distended with fluid as to affect the action of the heart or lungs.

Localised chronic peritonitis also occurs over ulcers and inflammations of the stomach, intestines, and other viscera, leading to the exudation of lymph and the formation of *adhesions*. We have already referred to the gravity of these adhesions in certain cases, and have pointed out that they may compress the organs over which they have formed, *e.g.* the

stomach and the intestines, or they may bridge over spaces between coils of intestine, and may thus lead to strangulation of the bowel beneath them, or they may cause intestinal obstruction by kinking. Apart from this, the adhesions may interfere with the proper performance of the functions of the organs and many cases of abdominal discomfort and obstinate dyspepsia are due to this cause.

It is not always possible to diagnose the presence of adhesions beforehand, except by a process of exclusion. In a good many cases the exact state of affairs is only discovered after an exploratory laparotomy, when division and removal of limited adhesions may cure the patient.

A non-suppurative peritonitis may result from *hæmorrhage into the peritoneal cavity*. After a blow on the abdomen it is not uncommon for a collection of blood to form, which, instead of becoming absorbed, remains and in its interior a cyst containing blood-stained serum is formed. These patients may be ill, and suffer from fever and pain. The evacuation and drainage of the cyst at once leads to improvement. In these cases a staphylococcus has been found which probably explains the symptoms.

CYSTS OF THE PERITONEUM.

Cysts occurring in the omentum and the mesentery are sometimes secondary to ovarian cysts—probably following an infection from a ruptured ovarian cyst—while sometimes they apparently originate in connection with lymphatic vessels and may even contain chyle. In other cases their origin is unknown.

Hydatid cysts are not very uncommon in the omentum or mesentery, and extra-peritoneal cysts have also been found in connection with the urachus. Blood cysts in the abdominal cavity have been referred to.

TREATMENT.—The true nature of these cysts is generally diagnosed only after the abdomen has been opened ; they may be mistaken for ovarian or renal tumours. The cysts must either be excised or drained ; in omental cysts excision can be carried out, but it is much less easy in mesenteric cysts on account of the risk of injury to the mesenteric vessels. In many simple cysts a good result is obtained by stitching the cyst wall to the parietal peritoneum, and then opening and draining it. The best plan is to unite the cyst wall to the edges of the parietal peritoneum by a continuous suture, leaving a surface exposed sufficient for the insertion of a drainage tube. An aspirating needle is first introduced into the cyst, and the greater part of its contents drawn off. This is done to avoid the possibility of the contents escaping into the peritoneal cavity. An incision is next made into the cyst and a large-sized drainage tube introduced. Should it be an hydatid cyst, the daughter-cysts should be evacuated before the drainage tube is put in, and a large opening will be necessary.

ASCITES DUE TO CIRRHOSIS OF THE LIVER.

Although not necessarily a disease of the peritoneum, this seems to be the most convenient place to refer to the modern treatment of ascites when it occurs as the result of obstruction of the circulation, usually from cirrhosis of the liver. In the cases of ascites due to other causes, paracentesis still remains the only surgical measure.

TREATMENT.—The treatment of this form of ascites may be either palliative or radical. In the former case the fluid is removed by tapping, the operation being repeated whenever the re-accumulation of fluid renders this desirable; in the latter an attempt is made to establish a collateral circulation or to drain the fluid into the lymphatic vessels outside the abdomen.

Paracentesis abdominis, or tapping the abdomen, is best done with the patient in the semi-recumbent position, so that he can be laid flat at once if he becomes faint. The spot selected for puncture is generally the middle line about two inches below the umbilicus, but in any case the puncture must be made into an area from which the bowel—as ascertained by percussion—is absent. The bladder should be emptied before the operation. The skin is purified in the ordinary manner and a broad bandage is arranged around the abdomen, which can be tightened as the fluid escapes. A nick is made through the skin with a scalpel, and a trocar and canula of appropriate length thrust rapidly through the abdominal wall. When the trocar is withdrawn, a long piece of sterilised india-rubber tubing is connected with the canula and the fluid is conducted into a suitable receptacle. Care must be taken to ensure asepsis throughout. A local anæsthetic may be employed if desired, but this is rarely necessary. The fluid should be allowed to escape very gradually; an hour may be necessary, otherwise faintness is apt to occur.

Some surgeons prefer *Southey's tubes*, and proceed in the following manner: The canula, guard, and tubing are all fitted together and the tubing is drawn sideways across the end of the canula, so as to form a diaphragm through which the trocar is thrust. The trocar and canula are then thrust into the peritoneal cavity and the trocar is withdrawn leaving the tube in position; the small hole made by the trocar in the tubing either falls together or is closed by pushing the tube a little farther on to the canula. As the flow lessens, the sides of the abdomen may be compressed either by the patient himself or by the broad bandage passed round the body. When the flow ceases, the tubing is disconnected, the finger is applied over the orifice of the canula and the instrument withdrawn. The opening is closed by a small pad of cyanide gauze fastened in place with collodion, and a firm binder is applied for a few days.

Radical treatment.—Only a limited number of cases are suitable for radical treatment. Cases of severe alcoholic cirrhosis in which the

patient is much broken down in health, syphilitic cirrhosis, cases with marked jaundice, or due to renal or cardiac disease are not amenable to operative treatment. It is the early cases of alcoholic cirrhosis, in which the ascites is just commencing but rapidly reappears after tapping, and the general health is good, that yield the most favourable results. A number of operations have been suggested for ascites, which fall into two classes. In the first, an attempt is made to establish an increased anastomosis between the portal and systemic circulations through the medium of adhesions between the omentum and the abdominal wall; in the second, a communication is established between the peritoneal cavity and the subcutaneous tissues, by means of which the increased amount of fluid in the peritoneal cavity may find an entrance into the general lymphatic system and thus be restored to the circulation.

The pathology of cirrhosis and the mechanics of ascites still present many problems, but it is fairly certain that the increased production of fluid is not due to a congestion of the portal system alone, although this is probably an important factor in many cases. It is not surprising, therefore, that the results obtained are far from uniform and that the indications for operation are not as yet definitely settled. For a recent discussion of the question, reference should be made to the ' Proceedings of the Royal Society of Medicine,' vol. 5, 1912. We shall here describe a typical operation from each group.

The Talma-Morison operation.—In this the great omentum is attached to the anterior abdominal wall, care being taken to obtain a wide area of attachment without damaging the main omental vessels. Morison summarises the operation as follows:

1. Open the abdomen from the ensiform cartilage to the umbilicus.

2. Introduce the hand into the abdomen and project a finger against the anterior parietes in the middle line three inches above the pubes.

3. Make a small incision on to the finger tip, and through this introduce a long, small glass drainage tube into the recto-vesical or recto-uterine pouch.

4. Dry the abdominal cavity and scrub the peritoneum with mops.

5. Suture the omentum to the anterior parietal peritoneum across the abdominal wall and close the upper abdominal wound. (In some cases a pocket is made in the sub-peritoneal tissues into which a portion of the omentum is drawn.)

6. Apply an antiseptic dressing over the wound and tube, and over the dressing and at a higher level than the tube put on a series of long strips of adhesive strapping passing round the body, with the object of keeping the parietal in contact with the visceral peritoneum.

7. The tube, now exposed through the dressing, is surrounded with a sterilised sheet of dental rubber, perforated to grasp it below its collar, and the separate tube dressing is wrapped up in the india-rubber sheet.

After-treatment.—The drainage tube is kept dry by aspiration, and

after about ten days is replaced by a small rubber tube which is shortened daily and ultimately removed altogether. It happens in some cases that symptoms of depression occur, which have been attributed to the introduction into the systemic circulation of blood, which has not passed through the liver; these symptoms are best treated by brisk purgation.

Abdominal lymphangioplasty.—The abdomen is opened below the umbilicus, and a series of silk threads are darned in and out through the parietal peritoneum over the iliac fossæ, the loops which project into the abdominal cavity being left fairly long. The threads are then carried underneath the outer part of Poupart's ligament and distributed in the subcutaneous tissue of the upper part of the thigh and buttock.

Another method consists in attempting to establish drainage through the femoral canal. The saphenous opening is exposed as for the radical cure of a femoral hernia and the canal dilated. The peritoneum is then sought for, and brought down and sutured to the edge of the opening beneath Poupart's ligament, or a hollow glass button is inserted in the ring. The wound is then sewn up and the ascitic fluid escapes into the cellular tissue in Scarpa's triangle and is absorbed by the lymphatic vessels.

CHAPTER XXIX.

HERNIA: GENERAL CONSIDERATIONS.

By the term 'hernia' is meant a protrusion of the contents of a cavity through its wall, and this may occur either through dilated natural openings or through parts weakened by injury or disease. We shall here deal only with abdominal hernia.

Constituents of a hernia.—A hernia is made up of a sac, with contents and coverings.

The great majority of abdominal herniæ possess a sac formed from the peritoneum, while in very exceptional cases there may be no sac; among the latter are herniæ of the cæcum and the bladder. The sac may exist previous to the descent of the hernia or it may be formed as the hernia comes down. An example of the former condition is the open funicular process in congenital inguinal hernia; in this form the contents pass into a canal which remains patent from fœtal life. In acquired herniæ the presumption is that the peritoneum is pushed through the weak part of the wall by the contents of the abdomen and forms the sac. Some surgeons deny the existence of acquired sacs and hold that they are all congenital, and only enlarge as the hernia develops, but this view is not generally accepted. In the early stages the sac is composed of the thin peritoneum, but in long-standing cases it may be much thickened; the most marked changes occur at its neck, which may become rigid and narrow instead of being distensible. Sometimes the fundus of the sac also shows constrictions, and in operating for strangulated hernia it is important not to mistake a constriction of this kind for the true neck of the sac.

Occasionally a double sac—or rather a diverticulum from the main one—is met with, and after herniotomy the contents of the lower portion of such a sac may be reduced into the upper instead of into the abdomen, and the strangulation thus be left unrelieved.

A hernial sac once formed is not reducible; when a hernia is reduced

the contents only are returned into the abdomen, leaving the sac lying in the canal.

The coverings of the sac consist of the structures superficial to the aperture through which the hernia passes, and are fully described in anatomical text-books. In practice it is often difficult or impossible to distinguish the various coverings, especially in old-standing herniæ which have become strangulated. The sac is recognised, after all the superficial structures have been peeled off, by its thin transparent appearance ; it possesses no large vessels, and if these are present after the sac has presumably been cleared it is certain that all the coverings have not been removed.

Most of the abdominal viscera have been found in hernial sacs ; the most common are portions of the omentum or the small intestine, or both together. The large intestine is not uncommonly present—especially in herniæ on the left side—and the cæcum, with or without a sac, the appendix, or the ovary may also be met with. Various important changes take place in the contents, which will be considered in connection with irreducible hernia.

The *causation* of hernia is a much debated subject. According to Hamilton Russell practically all herniæ are congenital in the sense that the sac is present at birth ; but a variety of predisposing causes may be mentioned, of which the chief are heredity, occupations entailing constant exertion in positions that leave the weaker portions of the abdomen unprotected, feeble abdominal muscles from faulty nutrition or debilitating illnesses, imperfect development of the abdominal wall, the distension of pregnancy, constant cough, marked straining—as in stricture of the bowel or urethra, phimosis, or enlarged prostate—various inflammatory affections of or operations upon the abdominal wall, and abnormal length of the mesentery.

The chief exciting causes are sudden strains while the body is in a position in which the abdominal orifices are not protected ; hence hernia is more frequent in men than in women.

The *symptoms* of hernia are too well known to need description.

Hernia may be *classified* in various ways. The cases may be divided into two great groups according as they form in connection with parts in which there is naturally a weakness of the abdominal wall—*e.g.* inguinal, femoral, or obturator hernia—or according as they protrude at parts where the walls have been weakened as the result of injury or disease. Again, they may be classed as *complete* or *incomplete* hernia ; a complete hernia is one which has passed through all the muscular coats of the abdomen, and an incomplete one is one still covered by one or more of the muscles, the typical examples being complete inguinal hernia, which has come out through the external abdominal ring, and incomplete inguinal hernia or bubonocele, in which the hernia is still in the inguinal canal. A third division is into *reducible* and *irreducible* hernia, according as the contents

can or cannot be completely returned into the abdomen. This is the most important condition from the point of view of treatment, and will be considered first.

Reducible hernia.—In this form the contents can be returned into the abdominal cavity by manipulation; with the exception of those having no proper peritoneal sac, all herniæ are usually reducible in the first instance.

Irreducible hernia. — Irreducibility is an extremely important factor and may depend on various conditions. We may distinguish the following classes: (*a*) simple irreducible hernia; (*b*) inflamed hernia; (*c*) obstructed hernia; and (*d*) strangulated hernia.

(*a*) **Simple irreducible hernia.** — By far the most common cause of irreducibility *is adhesion of the contents of the hernia to the wall of the sac*, and this may occur at the neck or in the body of the sac or in both combined; the adhesions are generally omental, but in long-standing cases the bowel may be adherent either to the omentum (which may also be adherent to the sac wall) or to the wall of the sac. Sometimes—especially in umbilical hernia—the omentum, the bowel, and the sac wall may be inextricably matted together. The adhesions are due to attacks of local peritonitis, and are often set up by the long-continued pressure of a badly fitting truss. Another cause of irreducibility is a *disproportion in size between the neck of the sac and the contents*. Thus the herniated omentum often increases in size from inflammatory exudation or by the deposit of fat, and cannot pass back into the abdomen; in these cases adhesions to the wall are also practically always present.

This condition may not give rise to any special symptoms, but sometimes there is a dragging pain from the pull on the intestine and this is often increased after food.

(*b*) **Inflamed hernia.**—This is due to inflammation following a direct injury or the pressure of a badly fitting truss. The inflammation takes the form of a localised exudative peritonitis which transforms a previously reducible hernia into an irreducible one.

The symptoms are often too slight to attract special attention; sometimes all that is noticed is that a truss cannot be worn on account of pain. When the inflammation is more severe, the condition may be mistaken for true strangulation, but can usually be readily distinguished from it; there is pyrexia, localised pain, and a definite impulse on coughing.

(*c*) **Obstructed hernia.**—This form of hernia borders closely on the strangulated one, in which it often ends. It is a hernia in which the passage of fæces is interfered with or entirely interrupted, without any true strangulation. The patient is very constipated and may suffer from colicky pains, but there is still an impulse in the hernia on coughing and none of the special symptoms of true strangulation. Strangulation may, however, supervene if the condition is not relieved, as the increasing distension of the bowel interferes with the circulation in the loop.

Another name sometimes given to these herniæ is *incarcerated hernia* ; the term is a bad one and there is no practical advantage in its use.

(*d*) **Strangulated hernia.**—Here not only is the passage of the contents of the bowel interfered with, but the circulation of the blood in the mesentery and bowel is also affected, and the condition becomes very grave. The mechanism is practically identical with that of acute intestinal obstruction from internal strangulation (see p. 332). The constriction is usually at the neck of the sac, and is often caused by that structure itself if it has become thickened—*e.g.* after the prolonged use of a truss ; in that case it forms an unyielding ring which prevents the return of the bowel and impedes the circulation of the blood. In other cases the constriction may occur at the opening in the abdominal wall through which the hernia passes—*e.g.* in femoral hernia, where Gimbernat's ligament plays an important part. More rarely still, the constriction is within the sac itself : for example, the bowel becomes strangulated either through a hole in the omentum or under adhesions between the latter and the sac wall ; this is not uncommon in umbilical hernia, and it is most important to bear it in mind in those cases. In operating on large strangulated omental herniæ the contents of the sac must not be put back *en masse*, but the omentum should be opened out first so as to make sure that no knuckle of bowel is caught in it.

The changes in the bowel in strangulation.—Congestion rapidly occurs in the strangulated loop and it soon becomes purple in colour or even black ; the lumen is distended and the walls become swollen and less supple. The peritoneal coat, which at first retains its polish, loses it, later on sub-serous hæmorrhages occur, and in the later stages it becomes grey and gangrenous—at first in spots and finally all over. All strangulated herniæ after a time become gangrenous, and it is most important to recognise impending gangrene. A mere dark colour does not imply gangrene so long as the bowel is firm and elastic and the peritoneal coat is glistening ; but directly the latter loses its polish and the bowel becomes soft, the condition is very grave. When gangrene is present, the gut becomes greyish, flabby, and collapsed and there are often soft greyish spots on the convexity of the loop where the peritoneum has lost its lustre. There is a definite sulcus at the seat of constriction and here the lesions are most profound, and gangrene usually occurs first. This part must therefore always be examined before the intestine is returned into the abdomen.

The changes are most marked in the proximal portion of the constricted loop, and are generally more intense along the convex than along the mesenteric border. In the former situation the bowel wall is thinned instead of being thickened, as is the rest of the loop, and it may be gangrenous. The mucous membrane is generally affected first, and most severely. Stricture of the bowel occasionally follows after an operation for strangulated hernia in which doubtful bowel has been

returned, presumably as the result of sloughing of the mucous membrane and subsequent cicatrisation of the ulcer.

The mesenteric vessels are involved, and extensive thrombosis of the veins may occur. This is a point of the greatest importance, because gangrene will certainly take place if the thrombosis is extensive, even though the bowel be not gangrenous at the time of the operation; moreover, the process is apt to extend and arrest the circulation in the neighbourhood. If a loop is returned with its mesenteric veins thrombosed it will become gangrenous later on in spite of the relief of the strangulation; moreover, unless the whole of the thrombosed area is removed at the original operation, the thrombosis may spread to neighbouring veins, and gangrene may still occur in the bowel beyond the seat of resection.

The changes in the omentum are similar to, but not as marked as, those in the bowel, and the omentum does not so commonly become gangrenous; it is usually matted together, tough, and œdematous. The presence of omentum in the sac along with intestine is a favourable condition, as it minimises the chances of gangrene of the bowel itself, because the constriction of the latter is rarely so tight as when it alone occupies the sac. When the omentum alone is strangulated the symptoms are not so severe as when bowel is present in the sac, and they may even subside spontaneously.

There is always some fluid in the hernial sac, and in a strangulated hernia it is abundant, being serous in the early stages, but later becoming blood-stained and finally fœtid, when gangrene sets in. Before this stage is reached the fluid usually contains organisms: at first the *Bacillus coli communis* is present, but when gangrene is impending, streptococci and other pyogenic organisms appear. This is an important reason in favour of operation in preference to taxis; it is not well to return fluid containing bacteria into the abdomen, although possibly in the early stages a few colon bacilli are of comparatively little consequence.

The *symptoms* of strangulated hernia are very characteristic, especially when the hernia contains bowel. The tumour is irreducible, becomes considerably larger than it was before, loses its impulse on coughing, is dull on percussion, tense, and tender to the touch. The general symptoms are identical with those of internal strangulation (see p. 330). When the hernia contains only omentum, the symptoms are not so marked, and the case may be mistaken for an inflamed rather than a strangulated hernia. The loss of the impulse on coughing in strangulation, however, is an important point; while in inflamed cases vomiting, though often present, is seldom fæcal, and constipation is not necessarily absolute although the bowels are usually sluggish.

Richter's and Littré's hernia.—A comparatively rare form of strangulated hernia is that known as *Richter's hernia*, in which only a portion of the circumference of the bowel is nipped instead of a complete loop. This probably occurs more often in femoral than in inguinal hernia, and is not

easy to diagnose as there may be no tumour present, unless there is also omentum in the sac. There may be no constipation because the lumen of the bowel is not actually interfered with ; vomiting may not be present, and flatus often passes freely. The constitutional symptoms, however, are often well marked ; the pulse is small and rapid, the breathing is hurried, and there is the same anxious aspect as in complete strangulation. The portion of intestine nipped is usually badly damaged, and gangrene often occurs quite early. In the condition known as *Littré's hernia*, Meckel's diverticulum becomes strangulated and the lumen of the bowel is not absolutely occluded.

TREATMENT.—The treatment of hernia depends on a number of varying conditions—such as the age of the patient, the situation of the hernia, its reducibility or irreducibility, the presence or absence of strangulation, and the general fitness of the patient for operative interference ; these points are dealt with in connection with the individual forms of hernia (see Chap. XXX.). We shall here only indicate the general principles of treatment.

As the most important questions with regard to the treatment of a hernia depend on its reducibility or irreducibility, we shall consider the treatment suitable for reducible and irreducible hernia respectively.

TREATMENT OF REDUCIBLE HERNIA.

The treatment of this form of hernia consists either in reduction of the hernia by manipulation, and its retention by a suitable truss, or in the so-called ' radical cure,' in which the contents of the sac are reduced, the latter obliterated, and the opening in the wall of the abdomen diminished or completely closed.

The question of operative *versus* non-operative methods is influenced by many considerations—*e.g.* by the nature and situation of the hernia, the probability of permanent cure by operation, the age and occupation of the patient, whether he is able to obtain medical assistance should strangulation occur, his health, and the size of the hernia. Further, no one suffering from a hernia is admitted to the public services—*e.g.* army, navy, police, and others—and operation may be desirable to enable them to do so.

Treatment in infants.—Hernia in infancy is usually umbilical or inguinal, and there is still a diversity of opinion upon the question of operation. Some surgeons delay the operation until the child is three or four years old, partly on the ground that the prolonged use of a truss may cure the hernia, partly because of the small size of the parts to be operated upon and the difficulty of keeping the wound clean, and partly because of the natural reluctance to operate on an infant unless it is absolutely necessary. Experience shows, however, that complete obliteration of the sac is not effected by a truss nearly so often as has been

supposed, and that though the hernia may not show for some time after the truss has been left off, it is apt to reappear under any severe strain. It is also found that infants stand operations very well, and that if they are nursed carefully on the lines laid down on p. 491 the operation can be conducted safely and with great advantage at a very early age. We therefore now perform the radical operation quite early in most cases of inguinal hernia in children. The details of the operations are given in connection with the various forms of hernia.

Palliative treatment.—If it is decided not to perform a radical operation, proper support must be afforded by suitable apparatus, and special care must be taken never to allow the hernia to descend into the sac. The actual management of herniæ in different situations is described separately. The truss must not irritate the peculiarly sensitive skin of the infant, it must be so designed as to press the sides of the opening together, it must be worn day and night, and in changing it the nurse must make efficient pressure over the opening and prevent the descent of the hernia while a fresh truss is being applied; the child should have a number of trusses, so that a clean one is always at hand, and a special india-rubber truss must be employed when bathing the child. Unless these precautions be taken, the hernia will often descend while the truss is being changed, and the chances of cure by this form of treatment will be extremely slight. The truss should be worn for several years.

Radical cure.—The best practice is to perform the operation during infancy; but if for any reason this course is not adopted it should not be delayed beyond the second or third year of life if the hernia still comes down when the truss is left off. From the point of view of permanent cure, there is no question that the earlier the operation is done the better; the longer the hernia lasts, the greater is the dilatation of the abdominal opening. Moreover, the continued pressure of a truss probably interferes with the proper development of that part of the abdominal wall. A radical cure done in infancy is usually very satisfactory; the abdominal walls develop as if no hernia had ever existed. In any case the radical cure should be done before the child is sent to school, for, if he has to wear a truss, he is likely to be at a great disadvantage; he cannot join in athletic sports, and he is constantly exposed to the ridicule of his schoolfellows, while he is not of an age to manage the truss himself, and the hernia is likely to come down beneath it and thus expose him to serious danger.

In adults.—Here the main question is whether radical cure should be performed, or whether the patient should wear a truss.

The question of 'radical cure' versus truss treatment.—The chances of curing a hernia by truss treatment in a young adult are slight, while the radical cure—of inguinal hernia, at any rate—is extremely successful. Numerous drawbacks affect a young adult with hernia; he is debarred from the public services, he is under many disadvantages in going abroad,

and is liable to frequent trouble with his truss which incapacitates him in many ways. He is often exposed to violent strains which cause the hernia to slip down behind the truss, he nearly always wishes to pursue occupations or amusements demanding full vigour, and he may be out of reach of medical aid for considerable periods.

We therefore strongly advise that, unless there be some definite contra-indication, a hernia in a young adult should be operated on by one of the methods described in Chap. XXX. The principal contra-indication is some illness which makes the patient an invalid or absolutely forbids operation.

On the other hand, however, feeble, old people with flabby abdominal walls, who are accustomed to wear a truss and do not object to do so, in whom the truss keeps up the hernia satisfactorily and whose occupation

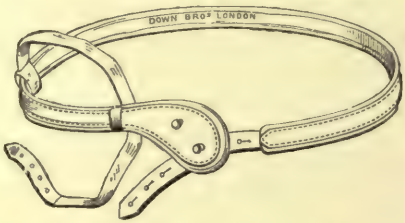

FIG. 151.—SINGLE TRUSS FOR INGUINAL HERNIA.

is sedentary, need not be urged to undergo the operation. In alcoholic and bronchitic subjects, operation is inadvisable.

The question is often raised as to whether the hernia is really cured by operation or not. In practice, it is found that the vast majority of operations done in childhood and youth are completely successful if done on proper lines (see Chap. XXX.), and even in elderly subjects the success is much greater than might be expected.

The least satisfactory cases are those in which a strangulated hernia is operated upon without any attempt being made to perform a radical cure. Here the abdominal opening and the neck of the sac have been enlarged at the operation, and when the patient begins to get about there is frequently a larger hernia than before, and this comes through a canal which is now cicatricial instead of muscular, so that there may be great difficulty in getting a truss to keep it up. Operations upon cases in which there is much cicatricial tissue seldom bring about a radical cure; nevertheless it is often necessary to perform an operation on the lines of the ordinary radical cure in these cases, the object being rather to enable the patient to wear a truss than to dispense with one altogether.

Palliative treatment.—This consists essentially in the employment of *trusses*; particulars of these are given in connection with the individual herniæ (see Chap. XXX.), but we may here indicate the general principles

underlying their use. The typical truss consists of a spring of tempered steel surrounding some part of the circumference of the pelvis ; to this is attached a pad so designed as to occlude the hernial orifice.

In the ordinary single truss (see Fig. 151) the spring encircles the trunk on the affected side ; one end is attached to the pad, while the other is continued round the other half of the pelvis by a strap attached to the pad by a stud. Most trusses are supplied with a perineal band which is fastened behind to the spring and in front to a stud on the pad. The pad varies in shape and in the material of which it is constructed, the shape depending essentially on the kind of hernia. It is usually a metal plate of suitable size and shape, firmly padded with horse-hair and covered with some soft material like chamois leather. Pads are also covered with india-rubber and may contain glycerine or air. Every truss should be

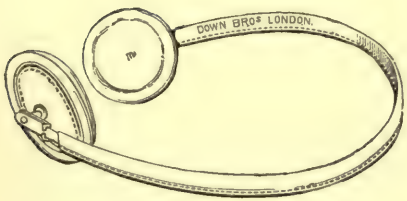

FIG. 152.—TRUSS FOR INGUINAL HERNIA. The spring passes round the sound side of the pelvis.

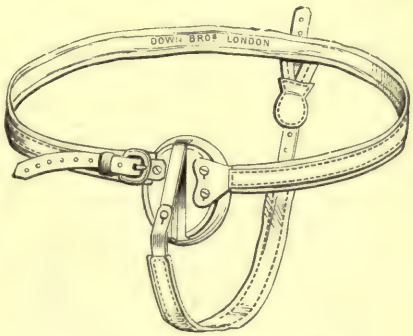

FIG. 153.—SPRING LEVER TRUSS.

made specially for the patient who is to wear it, and great care should be taken to shape the pad so as to retain the hernia. If a double truss is required, it may consist either of a single spring or, better, of two separate springs encircling the corresponding halves of the pelvis and fastened together behind.

A very comfortable form of truss is shown in Fig. 152 in which the pad is attached to the spring by means of a ball-and-socket joint.

Another form is the spring lever truss (see Fig. 153) which consists essentially of a pelvic and a perineal band, the pressure being made on a specially shaped pad by means of a spring. This is a very comfortable truss, but the pressure is slight and the pad is easily displaced. It is useful in small herniæ in subjects who do not have to undergo much strain.

A properly fitting truss should fulfil the following conditions : It should not inconvenience the wearer when sitting, while it should be powerful enough to keep up the hernia during any movement of the body ; this can rarely be effected without some spring apparatus. The size and

shape of the pad should be specified when ordering, together with some idea of the amount of force required to keep the hernia in position. The latter point is ascertained by reducing the hernia, keeping the thumb or forefinger over the orifice, and making the patient cough or strain. The size of the ring is also an important point and should always accompany the instructions to the instrument-maker. The surgeon should never leave the choice of the kind of truss to the instrument-maker.

In applying the truss the patient should lie down and reduce the hernia, which he usually does readily after a little practice. While he is in the horizontal position he should pass the spring of the truss around the body, the pad lying well above the hernial aperture. He now makes sure that the hernia is entirely reduced and then slips the pad into position ; the truss is then fastened and the perineal band applied. In order to test the efficiency of the truss the patient should be examined sitting and walking, and should be made to cough and to lift weights ; under all conditions a suitable truss should keep back the hernia.

The truss should be worn continuously night and day. Many authors hold that, unless there be some distinct reason—such as chronic bronchitis —it is needless to wear the truss at night, but there is no doubt that sudden movements in bed or during sleep, or a fit of sneezing or coughing may force down the hernia and lead to serious consequences ; quite a number of herniæ become strangulated during the night. As however the strain on the truss is only slight during the night, a much lighter spring may be used. An india-rubber-covered truss is required for use in the bath.

The skin beneath the pad is apt to become excoriated from friction and the accumulation of moisture ; the sweat decomposes and soaks into the pad which becomes hard and foul and is a further source of irritation. The parts should therefore be cleansed night and morning and dusted with equal parts of boric acid, oxide of zinc, and starch or powdered talc, while boric lint should be inserted between the truss and the skin to absorb the moisture ; it is also well to use linen covers over the pad, and these should be changed frequently.

If the truss causes pain it may be that it fits badly—in which case an alteration in the spring or a readjustment of the pad will remedy the discomfort—or that there is adherent omentum in the sac which becomes pressed on and gives rise to pain.

Careless patients may adjust the truss before the hernia is quite reduced and there is then pain and inflammation, and a previously reducible hernia may be transformed into an inflamed and irreducible one. A similar condition occurs when the truss does not keep up the hernia completely ; one of the commonest causes of irreducibility is imperfect truss support.

Much rarer complications caused by wearing a truss are adenitis and the occurrence of varicocele. These are generally due to too powerful a spring and are remedied by altering it or the shape of the pad. In

inguinal hernia one of the best pads is Wood's horseshoe pad (see Fig. 154), in which there is a deep notch allowing the cord to escape through the external ring without being pressed upon.

TREATMENT OF IRREDUCIBLE HERNIA.

A simple irreducible hernia is generally due to the presence of adhesions between the contents of the sac and its wall, but it may be due to increase in size of the contents after they have been in the sac for some time. In the great majority of cases irreducibility is due to the presence of omentum, which becomes adherent to the wall of the sac as the result of the application of a truss over an imperfectly reduced hernia, or which increases in size either as the result of the

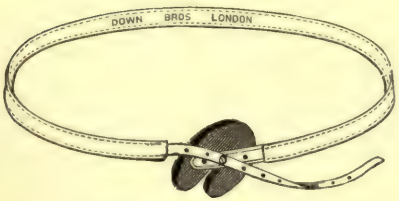

FIG. 154.—WOOD'S HORSESHOE PAD.

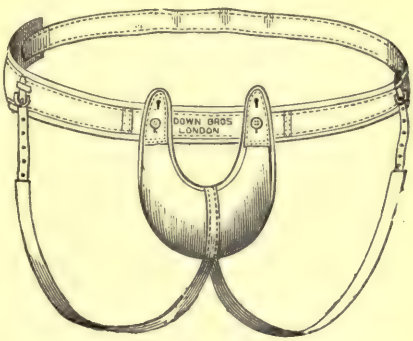

FIG. 155.—BAG TRUSS FOR IRREDUCIBLE INGUINAL HERNIA.

deposit of fat, or of inflammatory thickening, and can thus no longer be returned into the abdomen. Rarer causes are the presence of some viscus, such as the cæcum, in the sac.

In all cases of irreducible hernia it is advisable to perform a radical cure, unless there is some definite contra-indication. No form of truss will keep up the hernia, and therefore the patient is liable at any time to the occurrence of strangulation. If a truss is applied over an irreducible hernia with the view of preventing the descent of fresh portions of bowel or omentum, it causes irritation of the omentum which is not reduced, and may set up inflammation; in any case it makes the condition worse. The only kind of truss that is permissible in these cases is a hollow or bag truss (see Fig. 155), and this is rarely of much use as it is difficult to adapt it to the mass which it has to support.

The object of operation under these circumstances may be either to obtain a true radical cure or merely to enable the patient to wear a truss; the operation should be more strongly pressed than in reducible

hernia, and too much weight must not be laid on the patient's age. The size of the hernia must influence the question to some extent, and it may be safer for a very old subject, with a very large scrotal or umbilical hernia, or with grave constitutional disease, to wear a suitable bag truss than to undergo an operation for radical cure; in the great majority of cases, however, operation is the proper treatment.

Obstructed and inflamed herniæ are very important, because, if the condition persists, it is very apt to end in strangulation.

Operative treatment.—Unless there is a definite reason to the contrary, these conditions should be regarded as necessitating an immediate radical cure. The obstruction or inflammation may subside under treatment (*vide infra*), but these herniæ are usually irreducible, and a truss is therefore inefficient; moreover, the attack of inflammation is likely to give rise to increased adhesions in the sac, while it is impossible to be sure that strangulation may not supervene under unfavourable circumstances. There is no objection to operating on an obstructed or even an inflamed hernia, and the patient will probably submit at once if the state of matters is explained to him.

Palliative treatment.—Should the patient refuse operation or should it be considered inadvisable, he must be kept in bed on his back with the knees flexed over a pillow so as to relax the abdominal muscles as much as possible. Cold should be applied to the hernia, whether it be inflamed or simply obstructed, by means of Leiter's tubes or an ice bag. The diet should be fluid. Repeated enemata, which may contain from one to four drams of turpentine, should be given. Aperients should be avoided, but belladonna and strychnine may be given by the mouth so as to increase peristalsis. When there is no marked inflammation, very gentle and careful taxis may be applied from time to time, and in the intervals the hernia should be supported and compressed by a suitable elastic lace-up truss. The return of the hernia may be expedited by raising the foot of the bed on blocks. Opium should be avoided. Should signs of strangulation appear, immediate operation must be undertaken.

After the condition of obstruction or inflammation has passed off, the patient should again be urged to submit to a radical cure unless some serious contra-indication is present.

TREATMENT OF STRANGULATED HERNIA.

It is absolutely essential that the strangulation should be relieved and the bowel returned into the abdominal cavity with the least possible delay quite irrespective of the age or constitutional condition of the patient; there are only two methods of doing this—namely, by taxis or by operation. Unless the strangulation is relieved, the patient will almost certainly die; the number of cases which recover after the spontaneous

formation of an artificial anus is too small to be worth taking into account. Time should not be wasted upon such measures as warm baths, the administration of opium, or the application of ice; if any of these are employed it should only be while preparations are being made for operation.

In former days the principal method of treatment was by *taxis*, and it was only after failure of this that operation was resorted to. Nowadays, however, in view of the great safety and the great value of operative interference in herniæ which are not strangulated, operation has practically entirely displaced taxis. The great *objections to taxis* are that considerable force has often to be employed, and that, with a tight strangulation, the bowel may be so badly damaged by the procedure as to complicate subsequent operation very seriously; actual rupture of the bowel at the seat of constriction has occurred frequently as the result of forcible taxis. In order to apply taxis properly, an anæsthetic is necessary—and the anæsthesia is the chief risk of operating in these cases; the experience of radical cure amply proves that the risk of operation *per se* is practically *nil*. Other accidents may also happen in taxis: thus there may be a diverticulum from the sac under the abdominal parietes, and the external hernia may be pushed into this, and the strangulation remain unrelieved; the sac may rupture below the neck and the bowel may be reduced, still strangulated, into the sub-peritoneal tissues; the hernia and the sac together may be reduced *en masse* inside the abdomen; or the strangulation may have occurred beneath a band or through a hole in the omentum in the interior of the sac, and the hernia may be reduced as a whole without relieving the constriction. A further consideration is that in the reduction of a strangulated hernia by taxis, nothing has been done to effect a radical cure, and the condition may recur at any time.

Therefore, we unhesitatingly condemn the employment of taxis except in very rare cases. It should only be practised by the surgeon who is responsible for the entire treatment of the case, and he should be ready to proceed to operation at once should it fail or should any of the accidents mentioned above occur. It should not be carried out for longer than ten minutes in any case, and not so long, unless it be evident that an impression is being made upon the tumour. It should never be employed in femoral herniæ, nor in any hernia that has been strangulated for more than twenty-four hours.

Although we strongly condemn taxis as the ordinary procedure in strangulated hernia, we shall briefly indicate the chief points to be attended to in performing it. It should always be practised under an anæsthetic, either general or spinal. Before administering a general anæsthetic, the stomach should be washed out so as to diminish the risk of vomited material passing into the air-passages; it is well also to empty the bladder and the lower bowel. Taxis should be very carefully and gently employed,

and should if possible be attempted on a table and not on the bed. The pelvis should be raised, full relaxation should be secured by suitable position of the limbs, and the hernial orifice should be made the highest point of the abdomen. The surgeon grasps the neck of the sac with the left thumb and forefinger and pulls it down in the direction of the canal, and thus prevents the hernia, when pressed up by the other hand, from overlapping the edge of the orifice, and so guides it in its proper course. The entire hernia is grasped with the right hand, and gentle and equable pressure is exerted on it ; the tips of the fingers should not be pushed into the sac. The object is to squeeze out the contents of the incarcerated loop gradually, so that the emptied bowel may pass back through the ring. The experienced surgeon will soon be able to tell whether or not the taxis is likely to succeed. The chief indication of success is the gradual diminution in the size of the tumour. As the reduction goes on, the bubbling of gas is often felt ; when this happens, and not before, the compression of the sac is changed to a steady upward pressure so as to push the remaining loop through the hernial orifice.

Strangulated hernia in infants is a rare condition, probably owing to the fact that there is no definite fibrous ring developed in the neck of the sac. In these cases, therefore, inversion may be tried for five or six hours, when the hernia cannot be reduced by gentle taxis. The child is laid on his back on the seat of an arm-chair with his head towards the edge, and the buttocks are raised on a firm pillow and the legs tied with a scarf or bandage over the back of the chair so that the hernia is at the highest point of the abdomen. Gravity will generally serve to reduce the hernia.

Operation.—The steps of the various operations are described in connection with each particular form of hernia. In the first place the hernial sac and its coverings are exposed. The coverings are then divided, separated from the sac, and slit up until the neck of the sac is exposed. The sac is now gently pulled down so as to ascertain whether the constriction is in the neck itself, or is due to the rigid abdominal ring. In the former case, it is often possible to relieve the constriction by nicking the thickened neck ; in the latter, the ring should be enlarged in certain definite directions, either upon the finger-nail or upon a director insinuated between the neck of the sac and the abdominal parietes. If it be necessary to enlarge the opening in the abdominal parietes—*i.e.* to incise the ring—this is best done before the sac is opened, as there is then less risk of injuring the bowel.

The next step is to open the sac below the neck, taking care, however, to ascertain first that the bowel is not adherent to its wall. As a rule the sac of a strangulated hernia contains fluid which (except in old irreducible cases) distends it and removes its wall from the intestine. A small portion of the sac is pinched up and nicked, a director is introduced, and the sac laid freely open. The opening in the sac is then

carried up through the neck upon a director inserted beneath it. The contents of the sac are now inspected and the loop is gently pulled down so as to examine its condition at the seat of constriction ; if the bowel at once expands and does not show any loss of polish, it may be safely reduced.

The condition of the circulation in the bowel and its mesentery should also be examined so as to ascertain if the vessels are thrombosed, as this might interfere with its vitality. Before returning the loop, it is well to flush it with salt solution, especially if there has been much fluid in the sac. The omentum, if adherent and thickened, is pulled down until a normal portion is reached, and is then transfixed with a ligature threaded on an aneurysm needle ; the omentum beyond the ligature is removed and the stump returned into the abdomen. It is inadvisable to return omentum from a strangulated hernia into the abdomen as it may be a source of septic infection and may lead to intra-abdominal adhesions. Care must be taken in removing it not to go too near the tranverse colon, otherwise a kink may be caused ; at least an inch of omentum should be left between the point of ligature and the colon.

When there is no doubt as to the propriety of returning the bowel, the operation should be completed by a radical cure. The additional time occupied by this is trivial, and the immense advantage in performing it lies in the fact that not only is recurrence prevented, but the radical cure is done under much more favourable circumstances than if it were undertaken after the wound has healed, when a large amount of cicatricial tissue will be present.

In performing the radical cure, the sac should be excised, as it is generally in a bad condition and if left would probably be a source of infection. This should always be done, even when a radical cure is not undertaken. Before removing the sac, care must be taken to ascertain that no structures are adherent to its neck. The sac is sometimes abnormal and possesses constrictions or diverticula, and it is important that its entire extent should be exposed ; in an inguinal hernia, for example, the external oblique should be slit up to allow of this. If there is any doubt as to the vitality of the bowel, or the asepsis of the contents of the sac, it is a good plan to drain the abdomen through a stab-wound in the neighbourhood of the hernia and also to put a tube beneath the skin incision. This is more satisfactory than inserting a tube along the canal in which the hernia lay—a proceeding which would almost certainly nullify the radical cure.

Difficulties in the operation for strangulated hernia.—The two chief difficulties in the operation are the recognition of the sac wall and adhesion of the contents to the sac. When there is much omentum adherent to the sac wall and very little fluid, the layers of the omentum may be actually separated under the impression that the coverings of the sac are being removed. If there is any doubt, the best plan is to get as

near the neck of the sac as possible—and usually if the whole sac is exposed before an attempt is made to open it some point can be made out where fluid is present and where therefore it will be safe to incise ; the rest of the sac may then be freed before any attempt is made to reduce the hernia.

The intestine is only adherent to the sac when there have been recurrent attacks of inflammation, or when the large intestine is present —*e.g.* a cæcum without a proper meso-cæcum. The connection between the bowel and the sac wall may be so intimate that it is impossible to free them, and it may be necessary to return the bowel into the abdomen with a portion of the sac wall attached to it.

Unusual contents of the sac.—The *bladder* is not uncommonly found in connection with the sac in both inguinal and femoral herniæ, and may either bulge into it and form part of its contents or, more commonly, may be applied to the inner side of its neck, being pulled down along with the peritoneum ; it has happened that the fleshy mass in this situation has not been recognised as the bladder, and has been torn when separating the neck of the sac ; or, what is apparently still more common, a portion has been included in the ligature applied to the neck of the sac. Should the bladder be injured, the muscular coat should be stitched up and a tube left in the wound. If the bladder has been included in the ligature, there will be hæmaturia, pain on micturition, and irritability of the bladder, and should these symptoms arise, it would be wise to open up the wound, remove the gangrenous portion of the bladder and stitch up the opening.

Among other unusual structures found in a hernial sac are the *ovary* and *Fallopian tube* or the *appendix*. An appendix in a hernial sac, whether strangulated or not, is usually elongated and thickened, and may become the seat of acute appendicitis. Hence, it is always well to remove the process during the operation (see p. 417), unless the patient is so feeble that he cannot stand any prolongation of the operation. The ovary or Fallopian tubes should be returned unless they are considerably damaged, in which case the comfort of the patient will be best secured by removing the affected parts.

Treatment when the vitality of the contents is defective.—If the surgeon finds that the sac contains blood-stained fluid, that the bowel is of a deep purplish brown colour, and that the peritoneal coat has lost its shining appearance in places and shows greyish or greenish-brown patches, the condition is one of commencing gangrene of the intestine. Even when the strangulated loop is still alive, gangrene may be occurring at the seat of constriction, or the vessels in its mesentery may be thrombosed, and gangrene must therefore result. The prognosis in these cases is extremely grave.

Intermediate between the cases in which the loop is evidently sound and those in which it is obviously gangrenous are quite a number in

which the surgeon is not sure whether it will recover or whether it will become gangrenous. An important point is the condition of the circulation in the loop after dividing the stricture ; if this improves during the course of the operation the loop will probably recover. If small greyish patches or hæmorrhages beneath the peritoneal coat are present in a bowel not yet actually gangrenous, subsequent perforation is very likely to occur ; the danger of returning bowel into the abdomen in this condition is very great.

When the condition of the bowel is suspicious it used to be the practice to return the bowel into the abdomen and to leave the doubtful part just inside the hernial aperture after having relieved the constriction and washed

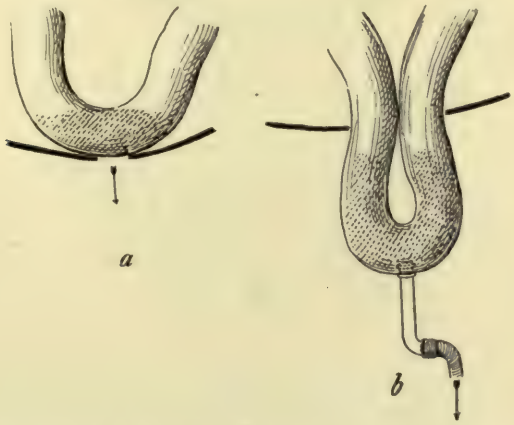

FIG. 156.—DIAGRAM ILLUSTRATING THE METHODS OF TREATING A LOOP OF STRANGULATED INTESTINE WHEN GANGRENE IS IMPENDING OR IS ACTUALLY PRESENT. In *a* the suspected loop (shown dotted in the figure) is returned just within the ring, through which free drainage, in the direction of the arrow, is provided. In *b* a Paul's tube has been inserted and a fæcal fistula established.

the loop with salt solution ; large drainage tubes and a few strips of gauze were also introduced into the canal up to the doubtful part of the bowel. The reason for this plan was that no second operation to replace the bowel in the abdomen would be required should recovery of the gut take place, while it was hoped that the affected portion would be shut off from the general peritoneal cavity by adhesions, and that the contents would escape along the drains (see Fig. 156, *a*) should perforation occur in the suspected loop. The suspected coil, however, may easily be dragged away from the opening by peristaltic action unless it is fixed by stitches—a plan to which there are many objections ; while if the strangulated loop is large, perforation might occur at some part not in the neighbourhood of the drainage.

A better plan is to divide the neck of the sac, cleanse it and the suspected loop, and pull down the latter beyond the constriction, and then

fix it in the wound either with strips of gauze or by stitches. The wound should be left open and covered with Lister's protective or thin sheet rubber until it is seen what is going to happen. If gangrene and perforation occur, a moist boric dressing should be applied until the sloughs have separated; if the bowel recovers, the patient should be put under an anæsthetic, the newly formed adhesions gently separated

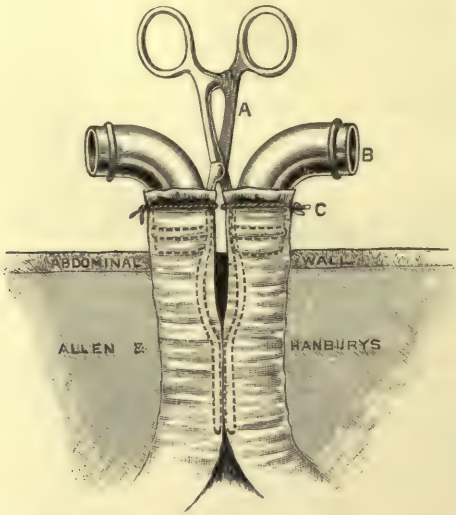

FIG. 157.—INTESTINAL ANASTOMOSIS FORCEPS FOR GANGRENOUS BOWEL. The object of this instrument (which was introduced by Mr. Edmunds) is to provide a lateral anastomosis at some distance from the opening of the bowel, and at the same time to drain off its infective contents (see *Practitioner*, March, 1908).

The two ends of the bowel are arranged so that their lateral or antimesenteric borders are in apposition. One blade of the clamp is slipped down inside each piece of gut and the instrument closed. The bowel between the blades of the forceps sloughs away, leaving an opening, the edges of which are united by plastic peritonitis. The mechanism is exactly that of the Murphy's button. As soon as the forceps are in position, the modified Paul's tube is slipped into the upper end of the bowel in such a way that the shank of the forceps occupies the groove in the side of the tube; the forceps, the tube, and the bowel are fastened together with a stout silk ligature (C). This process is now repeated with the lower end of the bowel. In order to prevent displacement of the bowel one or two sutures may be inserted between its muscular coats and the skin. The forceps are to be left in position for a week and then withdrawn, leaving the patient with a small intestine fistula and a lateral anastomosis.

with the finger, the bowel returned into the abdomen, and the wound closed.

When there are only one or two suspicious spots on the bowel and it is decided to return the latter, it is well to invert the suspicious areas by Lembert's sutures so that perforation will not take place into the abdominal cavity should they become gangrenous.

When there is actual gangrene of the bowel the case may be seen before or after perforation has occurred. In the former event the surgeon has the choice of two procedures—namely: (1) excision of the affected loop followed by immediate anastomosis and return of the bowel into the

abdomen, or the temporary establishment of an artificial anus which will be closed at a later period ; or (2) division of the constriction followed by fixation of the affected loop well down in the wound, so that adhesions may form round the abdominal opening and the perforation take place outside. This gives rise to an artificial anus, which must be subsequently closed.

Immediate resection and anastomosis.—The plan that should always be adopted if possible is resection of the affected loop followed by immediate union (see p. 324). The surgeon must be guided in his decision by the patient's general condition and by the condition of the bowel above the constriction ; it is not so much the increase in the severity of the operation that makes immediate resection and anastomosis a more dangerous procedure than draining the bowel, but the fact that the contents of the intestine are not removed, and hence the patient is liable to die of toxæmia. If there is no great distension of the bowel the results of resection are good ; but when there is distension of the intestine with foul contents, the results are very unsatisfactory, unless drainage can be established in one of the ways already described (see p. 341).

If it is found on opening the sac that the bowel has perforated, the condition is very serious. It would be most dangerous to divide the constriction at the neck of the sac and either pull down the loop or perform an anastomosis, on account of the risk of fouling the peritoneum ; as a rule, the less done in the way of disturbing the neck of the sac the better. The best plan is to cut off the sloughing portion of the bowel, leave the wound wide open, and provide free drainage so that the separation of the sloughs can take place without risk to the adhesions which have already formed between the neck of the sac and the bowel passing through it. At the same time tubes may be introduced into the open ends of the bowel so as to assist in draining away its contents (see Fig. 157). In most cases the contents of the bowel above can readily pass the constriction. Sometimes, however, the relief is imperfect, and, if the patient's condition is fairly good, it would then be legitimate to cover up the hernial wound and to make an incision in the middle line and effect a lateral anastomosis between the afferent and efferent limbs of the loop so as to allow the proximal portion of the bowel to pass its contents freely into the distal, while at the same time the sloughing portion is cut out of the circuit and left in the wound. This procedure frees the patient from the obstruction, and in some cases the open ends of the bowel close and no further operation may be necessary ; if they do not, the abdomen may be opened at a later period, and the affected portion of the intestine excised and a lateral anastomosis made between the upper and lower portions.

CHAPTER XXX.

HERNIA: THE TREATMENT OF THE INDIVIDUAL FORMS.

INGUINAL HERNIA.

THERE are two forms of inguinal hernia which must be considered separately—namely, the *congenital form* in which the sac has existed, from birth, and the *acquired form* in which the sac is probably newly formed.

In congenital hernia—of which there are several varieties—the sac is the unobliterated portion of the funicular process of the peritoneum, and various conditions may be present (see Fig. 158). The process may be patent from end to end—the cavity of the peritoneum above being continuous with that of the tunica vaginalis below; it may be obliterated with the exception of a small funnel-shaped portion at the upper part; or the upper part alone may be obliterated, so that a hernia, pushing a fresh sac before it, invaginates the unobliterated portion of the funicular process below—the so-called 'infantile hernia.'

Inguinal hernia may also be divided into the *oblique* and the *direct* forms. The ordinary oblique inguinal hernia descends along the cord from the internal abdominal ring, and may be congenital or acquired; the direct form passes out on the inner side of the deep epigastric artery, either stretching or perforating the conjoined tendon, and is always acquired.

REDUCIBLE OBLIQUE INGUINAL HERNIA.

Cure may occasionally, but rarely, follow the continued application of an efficient truss in the congenital herniæ of infancy and early childhood; if the hernia is kept reduced from the first, the funicular process may become obliterated, partly in the course of the natural development

of the parts and partly as a result of the continued pressure, and a cure is thus brought about. The cure of an acquired hernia by the use of a truss is of rare occurrence.

In infancy.—In infants there is much difficulty in keeping a truss clean and in place, and during the first year of life it is well to use a *bandage* instead of a truss (see Fig. 159) ; this may be washed and used

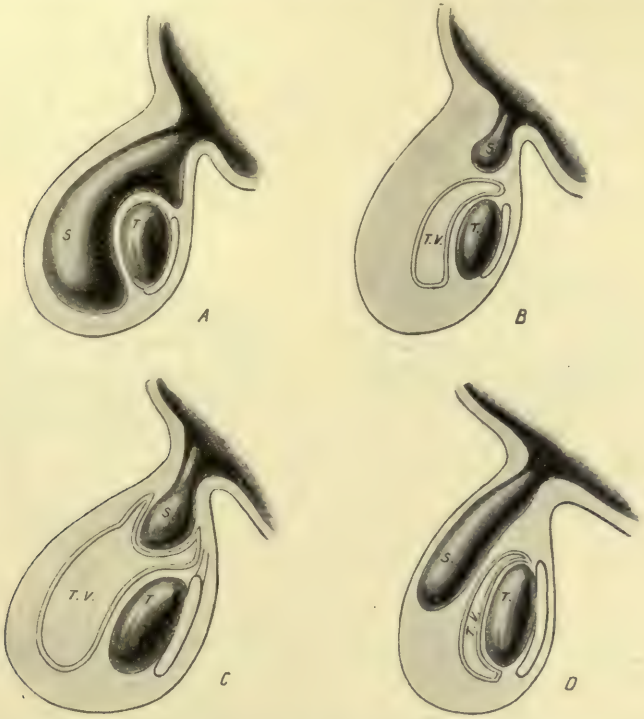

FIG. 158.—DIAGRAM OF THE VARIOUS TYPES OF OBLIQUE INGUINAL HERNIA. The arrangement of the peritoneum is shown with regard to the tunica vaginalis. *A* is the ordinary congenital type, *C* is the so-called 'infantile hernia,' *B* is the hernia into a patent funicular process, and *D* is the ordinary acquired form.

again, and, though not so efficient as a well-fitting truss in an older child, is valuable when properly used in the very young. The method usually adopted is as follows: The skin is powdered with fullers' earth or equal parts of oxide of zinc, boric acid, and starch, and a long strip of flannel two inches broad is taken and doubled in half. The loop is applied over the internal abdominal ring and the doubled strip is carried obliquely upwards across the iliac region on the same side as the hernia, around the pelvis behind, midway between the iliac crest and the great trochanter, and the ends are brought forward and carried through the loop from above downwards. The hernia is now reduced

—although an effort should always be made to keep it from descending during the changing of the bandage—and, the bandage is drawn tight with the point at which the ends pass through the loop exactly over the internal ring. The free ends are carried round the fold of the perineum, brought up behind the buttock on the affected side, and fastened to the horizontal limb of the bandage; while this is being done pressure is made to keep up the hernia.

The loop is stitched at the point where the ends of the bandage pass through it, in order to prevent it from slipping. Unless the hernia is large this arrangement will generally keep it up; should the hernia descend behind the bandage it usually means either that the pressure is not applied at the proper spot or that the band has not been drawn tight

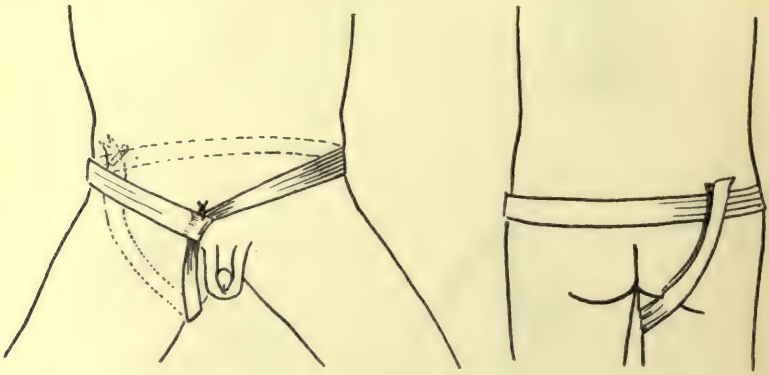

FIG. 159.—THE FLANNEL BANDAGE FOR INGUINAL HERNIA IN INFANTS. The sketches show how the bandage is looped so as to exert pressure over the inguinal canal.

enough. In a bilateral hernia a similar bandage may be used for the opposite side. The child should be bathed before the bandage is removed, and then it should be taken off and a fresh one applied; the old one can be washed and used again when dry.

A skein of worsted is often used instead of the flannel; one loop is brought over the seat of the hernia and the other end of the skein is passed round the pelvis as before, brought through this loop, and the whole is tightened up until the point of junction is over the internal ring, when the free end of the skein is carried down between the legs and fastened to the horizontal limb as described above. The objection to the worsted is the expense, because this sort of truss in an infant must be changed several times a day, and the worsted soon shrinks and becomes hard, while the individual threads mark the skin and cause discomfort; on the whole the flannel is preferable. The difficulty with these bandages is that the mother or nurse often fixes them wrongly. It is not sufficient to explain

or even to demonstrate the method; the person in charge of the child must apply it herself on several occasions in the surgeon's presence.

If the flannel bandage keeps up the hernia efficiently it should be worn continuously for eighteen months or two years and then left off; if the hernia has now disappeared, well and good; if not, a radical cure (see p. 483) should be done.

If *trusses* are employed in very young children they must be covered with india-rubber, and great care must be taken to keep the skin under them dry and clean. Two or three trusses should be provided for each case so that each can be cleaned after removal; the skin is washed and powdered, and boric lint is applied between it and the pad of the truss. With a careful and intelligent mother, who sees that the hernia does not descend during the changing of the truss, the result may be very satisfactory; a careless one will often mismanage the child to such an extent

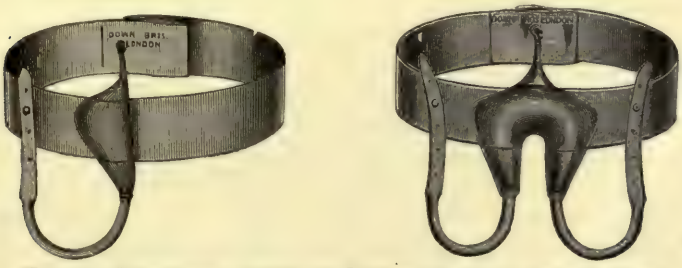

FIG. 160.—INDIA-RUBBER TRUSSES FOR INGUINAL HERNIA IN YOUNG CHILDREN. The pad is inflatable. The left-hand truss is for a unilateral, the right-hand for a bilateral hernia.

that the skin becomes excoriated beneath the pad, and the truss has to be left off. Further, poor patients can only afford one truss, which soon becomes foul and irritating. The ordinary spring truss, although constantly recommended, is not at all satisfactory in children under two years of age; the body is most difficult to fit, the child is growing rapidly, and the pad is usually either inefficient or exerts injurious pressure.

When the abdominal ring is very large a flannel truss will not act; in an infant, in whom the conditions are unfavourable for a radical cure, the truss shown in Fig. 160 may be tried; this consists of a broad india-rubber band encircling the pelvis, to the front of which are fixed one or two pads of india-rubber, according to the nature of the case, which are distended with glycerine, water, or air—the latter by preference—and kept in position by india-rubber perineal straps.

Should the truss fail to keep up the hernia *radical cure* must be performed, and, as we have already said on p. 465, operation is preferable to treatment with trusses in all these cases. The steps of the operation are detailed on p. 483; after it we do not use any bandages or dressings, as they only become soaked with urine (see Fig. 167).

In adults.—The remarks already made upon the question of a radical cure *versus* a truss (see p. 465) apply in their entirety to inguinal hernia.

Trusses.—Should it be decided that the patient is to wear a truss—and even if operation is decided on, a truss should be worn until it is performed—the following points must be attended to in ordering the truss. The circumference of the pelvis is measured from the centre of the external ring to a point midway between the top of the great trochanter and the crest of the ilium, and then horizontally around the pelvis on this level back to the centre of the ring. The sex, occupation, and social habits of the patient should be notified, together with some idea of the size of the ring and the amount of pressure required to keep up the hernia. It is also well to state whether the patient is stout or not, and whether a perineal band will be required; this, as a rule, is only essential when the abdomen is very flat, as in the opposite condition there is no great tendency for the truss to slip up. The pad should be as flat as possible, and just large enough to overlap the ring in all directions and to press on the lower end of the inguinal canal. It must be so arranged that the vas deferens is not pressed upon, and if the ring is large and considerable pressure is required, it is well to employ the horseshoe pad designed by the late Professor Wood, which avoids pressure on the cord (see Fig. 154). Wood's horseshoe truss is also useful in direct herniæ, because in these cases the ordinary truss is apt to press upon the cord; it is also suitable for those who are very susceptible to pressure and who rapidly develop varicosity of the veins of the cord as a result. The ordinary spring truss takes its purchase behind over the sacrum, and should pass round the body midway between the iliac crest and the top of the great trochanter. It should lie flat against the skin everywhere, except near the junction of the spring with the pad.

Special trusses are used for cases of retained testicle complicating a hernia, for scrotal hernia (see Fig. 161), and for irreducible hernia (see Fig. 155); but in our opinion these are very rarely called for. In all these cases a radical cure should be performed, unless there is some very serious contra-indication. When the muscles are very lax, the subjects very fat, and the herniæ very large, the radical cure may not be permanent; but even then it is of great value, as it allows the patient to wear an ordinary truss.

When a radical cure is not performed for a reducible scrotal hernia, a form of truss is often used which has a strong spring and a triangular-shaped pad—the so-called 'rat-tailed truss' (see Fig. 161). A strap passes from the lower angle of the pad, under the perineum, and is fastened to the spring on the same side of the body as the hernia. The perineal band in this truss is meant to exert direct pressure upon the canal, while that in the ordinary form merely prevents the pad from slipping up. This truss must never be used unless the hernia is completely reducible.

In cases of hernia complicating undescended testicle a cup-shaped truss is often employed to receive the testicle, whilst its rim keeps up the hernia. We consider, however, that it is always advisable to operate on these cases, partly in order to perform a radical cure of the hernia and partly to remedy the undescended testicle, and it is open to question whether a truss should be worn at all. The hernia, which is practically always present, helps the descent of the testicle, and the neck of the sac being wide, there is little risk of strangulation. When the child can be under close observation we are therefore inclined to allow some time to elapse before operating, and to prohibit the use of a truss so as to favour the descent of the testicle as much as possible.

The first point in applying a truss is to reduce the hernia. The patient lies flat on a couch, and the thigh on the affected side is flexed and rotated inwards. The neck of the sac is then grasped between the thumb and

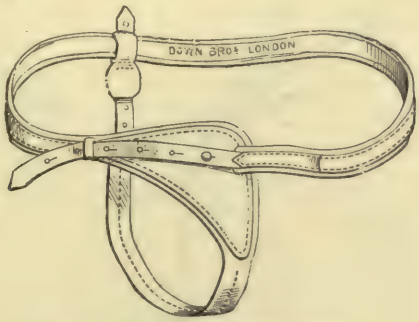

Fig. 161.—Truss for Scrotal Hernia.

forefinger of one hand and pushed firmly downwards and inwards; the bulk of the tumour is then grasped in the palm of the other hand and the swelling compressed and gradually squeezed up towards the inguinal ring. Compression is first employed in order to empty the contents of the bowel, and when this has been done the contents of the sac are returned into the abdomen by steady upward pressure. Many patients become very expert at this. After the hernia has been reduced, two fingers are placed firmly over the canal so as to prevent it coming down, the truss is slipped round the body, and the pad is placed in position.

Radical cure.—Many operations have been introduced for the radical cure of inguinal hernia; they differ a good deal in detail and applicability. We shall first discuss the essential principles of the operation of radical cure—namely, obliteration of the hernial sac and closure of the canal along which the hernia has come—and shall then describe the operations for the acquired, the congenital, and the direct forms of hernia.

The treatment of the hernial sac.—It is hardly necessary to mention that, when a hernia is reduced into the abdomen, the sac remains behind.

An essential part of any operation is the complete obliteration of this structure, for, if it be left patent, the hernia will come down into it again however the canal may have been dealt with. It is most important not only that the sac should be removed, but that not even a dimple should be left at its neck.

Obliteration of the sac may be effected in several ways. The one most often employed is *ligature and removal of the whole sac and displacement of the stump.* A needle carrying a double thread is passed through the peritoneum just above the neck of the sac, after it has been cleared both of its contents and its coverings, and these threads are tied on each side and the sac cut away. One end of each thread is left long, the

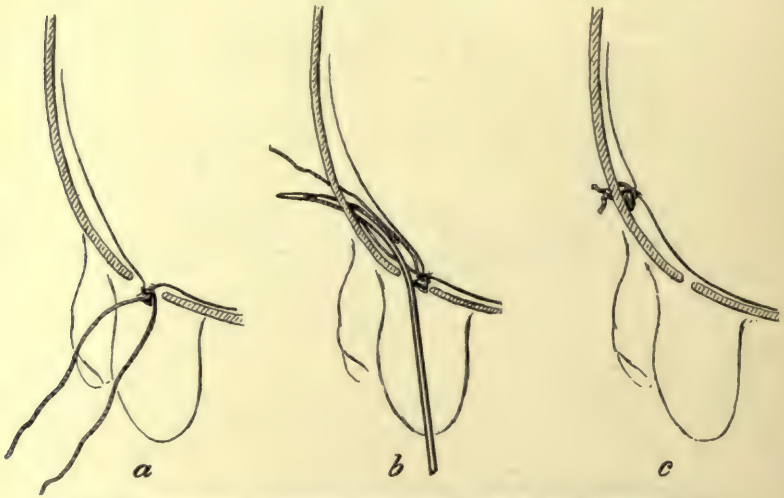

FIG. 162.—METHOD OF TREATING THE NECK OF THE SAC BY LIGATURE IN THE RADICAL CURE OF HERNIA. In *a* the neck of the sac has been ligatured and the sac itself cut away, *b* and *c* show how the ends of the ligature around the neck of the sac are passed through the abdominal walls, so that when they are tied the peritoneum is drawn flush over the ring and all trace of a hernial dimple is obliterated.

peritoneum is separated from the muscles by the finger, and the ends of the ligatures are then carried through the abdominal muscles from behind forwards at a point well above the ring, so as to drag the stump well away from the hernial orifice (see Fig. 162).

This is a very efficient method, but it must be done thoroughly. If the sac is ligatured a little below the neck, a funnel-shaped projection is left into which a hernia may again find its way. It is, therefore, essential to remove the neck as well as the body of the sac, and in order to do this satisfactorily it is advisable to slit up the external oblique. The vas must be separated from the neck of the sac. It is also important to see that none of the contents are adherent to the neck of the sac or protrude through it, otherwise they may be injured. The neck of the sac itself must be carefully cleared ; neglect of this precaution has led, for example,

to inclusion of a portion of the bladder in the ligatures, but this is only likely to happen in a direct inguinal or a femoral hernia.

Another method is *torsion of the sac*. The neck is cleared, the sac is opened so as to make sure that there are no adhesions either in the sac or at the neck, the latter is steadied by grasping it with the left thumb and forefinger, and the fundus is seized with forceps and twisted up tightly, the spermatic cord being held out of the way. In this way the upper end of the sac can be obliterated absolutely without any risk of

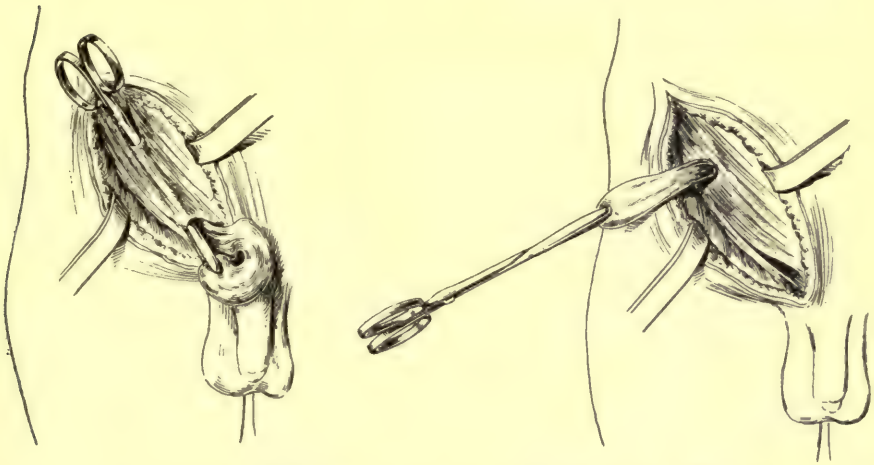

FIG. 163.—KOCHER'S METHOD OF TREATING THE SAC IN RADICAL CURE OF INGUINAL HERNIA. The finger is first passed up the canal behind the external oblique, and a long pair of forceps are thrust through the latter on to the finger and guided by it down the canal and out at the external ring, where the fundus of the sac is firmly seized, as shown in the left-hand figure. The forceps are then withdrawn carrying the sac with them, as seen in the right-hand figure. Finally the fundus of the sac is laid down on the outer surface of the external oblique, directly over the inguinal canal, and secured firmly in place by a series of sutures which first pass through the muscle, Lembert-fashion, on one side of the sac, then right through the sac, then finally through the external oblique, again Lembert-fashion, on the opposite side of the sac. When these sutures are tied the sac is immovably incorporated with the abdominal wall. If preferred, the neck of the sac may be secured to the opening in the external oblique after the fundus has been cut away.

injuring the bladder or other structures ; indeed, a large amount of the peritoneum can be stripped off the abdominal wall. Previous to twisting the sac, the finger is introduced between the transversalis muscle and the peritoneum, and a bed for the reception of the twisted sac is formed above and to the outer side of its neck. The twisting is carried on until the sac gets into a knot, when the forceps are pushed up into the bed previously prepared, and the mere pressure of the abdominal wall prevents untwisting when the muscular wall is strong.

Among other methods of dealing with the sac may be mentioned Macewen's, in which the sac is pursed up ; and Köcher's, in which the twisted sac is brought out through the external oblique tendon (see Fig. 163). In all cases the sac must be removed from the inguinal canal,

whether it is cut away or not ; to leave the remains of the sac in the inguinal canal is to leave a mass which prevents proper closure of the canal and which of itself is not a satisfactory barrier to the descent of the hernia.

In *direct hernia* the condition is different, and frequently none of these methods can be employed ; as a rule, there is no narrow neck to the sac, and it is impossible either to twist or to purse up the neck sufficiently to ligature it. In the oblique form also, when the cæcum is in the sac, portions of the latter must be put back with the intestine, and no satis-

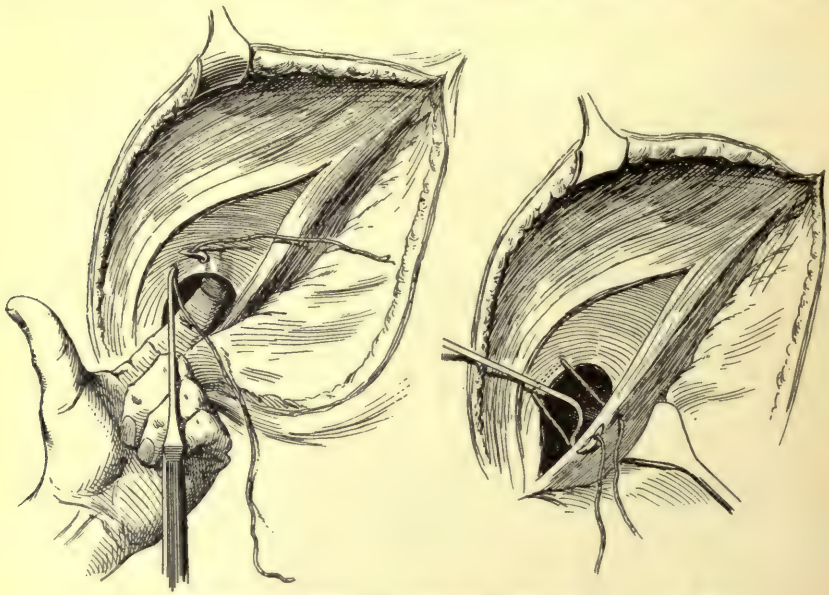

FIG. 164.—MACEWEN'S METHOD OF CLOSING THE INGUINAL CANAL IN RADICAL CURE OF HERNIA. The left-hand sketch shows the method of passing the suture through the conjoined tendon, while the right-hand one shows the ends of this suture passed, one through the fascia lata of the thigh just below Poupart's ligament, and the other through the ligament itself.

factory neck is left. Under these circumstances closure is best effected by cutting away the sac altogether and stitching up the peritoneum as in an ordinary laparotomy.

The methods of dealing with the canal.—This question is one about which there is considerable difference of opinion. The first question —whether steps should be taken to close the canal at all—depends, we believe, on the age of the patient and the condition of the abdominal walls. There is no doubt that the essential point in the operation for radical cure is complete obliteration of the sac, but, when the abdominal walls are lax and atrophied or stretched by the prolonged existence of a large hernia, a fresh protrusion of peritoneum may occur, unless the sides of the canal are also approximated. In children, on the other hand, the

hernia is often due to the existence of an unobliterated portion of the tunica vaginalis and not to muscular insufficiency, and the large majority are cured by simple obliteration of the sac without suture of the inguinal canal; indeed, the arrangement of the muscles is such that they close the inguinal canal when they contract, and the insertion of stitches might interfere with their proper action. In the herniæ of adults, however, and especially when the hernia is large, when the muscles are thinned and spread out over the sac, and in old or fat people, it is advisable to bring the sides of the canal together by stitches in addition to obliterating the sac, and this can be done in various ways.

In *Macewen's* original method the conjoined tendon is brought down to Poupart's ligament behind the cord with stout mattress sutures. A suture is passed through Poupart's ligament by means of a suitable needle, carried across the inguinal canal behind the cord, and made to perforate the conjoined tendon; the end of the stitch is then seized and the needle withdrawn. The upper end of the stitch is again threaded on the needle, which is now inserted through the internal oblique and transversalis muscles, carried back again across the canal and brought out through Poupart's ligament about an inch farther out than the point at which it entered (see Fig. 164). The ends are pulled tight and tied, and thus the floor of the inguinal canal is repaired.

When the muscular wall is feeble *Bassini's* method effects more complete closure of the canal. The external oblique tendon is slit up so as to expose the whole canal, the cord is hooked down out of the way, the lower edge of the internal oblique, the transversalis, and the conjoined tendon are defined and separated from the peritoneum by the finger, and sutures are inserted so as to bring this edge into apposition with Poupart's ligament throughout, except at the outer end where just enough room is left for the cord to emerge. This may be done by a continuous suture, but we prefer to employ two or three mattress sutures similar to those recommended by Macewen. The first stitch is inserted as near the internal ring as possible, just allowing room for the cord to emerge; if the veins are large some of them may be excised; the lowest suture is in the conjoined tendon. The cord is then laid down in place, and the divided edges of the external oblique and the pillars of the external ring are carefully sutured over it, leaving the external ring just large enough for the passage of the cord (see Fig. 165). This is a more effectual operation than Macewen's for all cases in which the canal has to be diminished in size.

In *Halsted's* method the inguinal canal is closed completely and the cord is brought out through the tendon of the external oblique and lies beneath the skin and subcutaneous tissues. This method is rarely employed.

The foregoing are the chief methods of dealing with the inguinal canal, and we make use of them, or modifications of them, according to circumstances. In young children with strong abdominal walls we do not

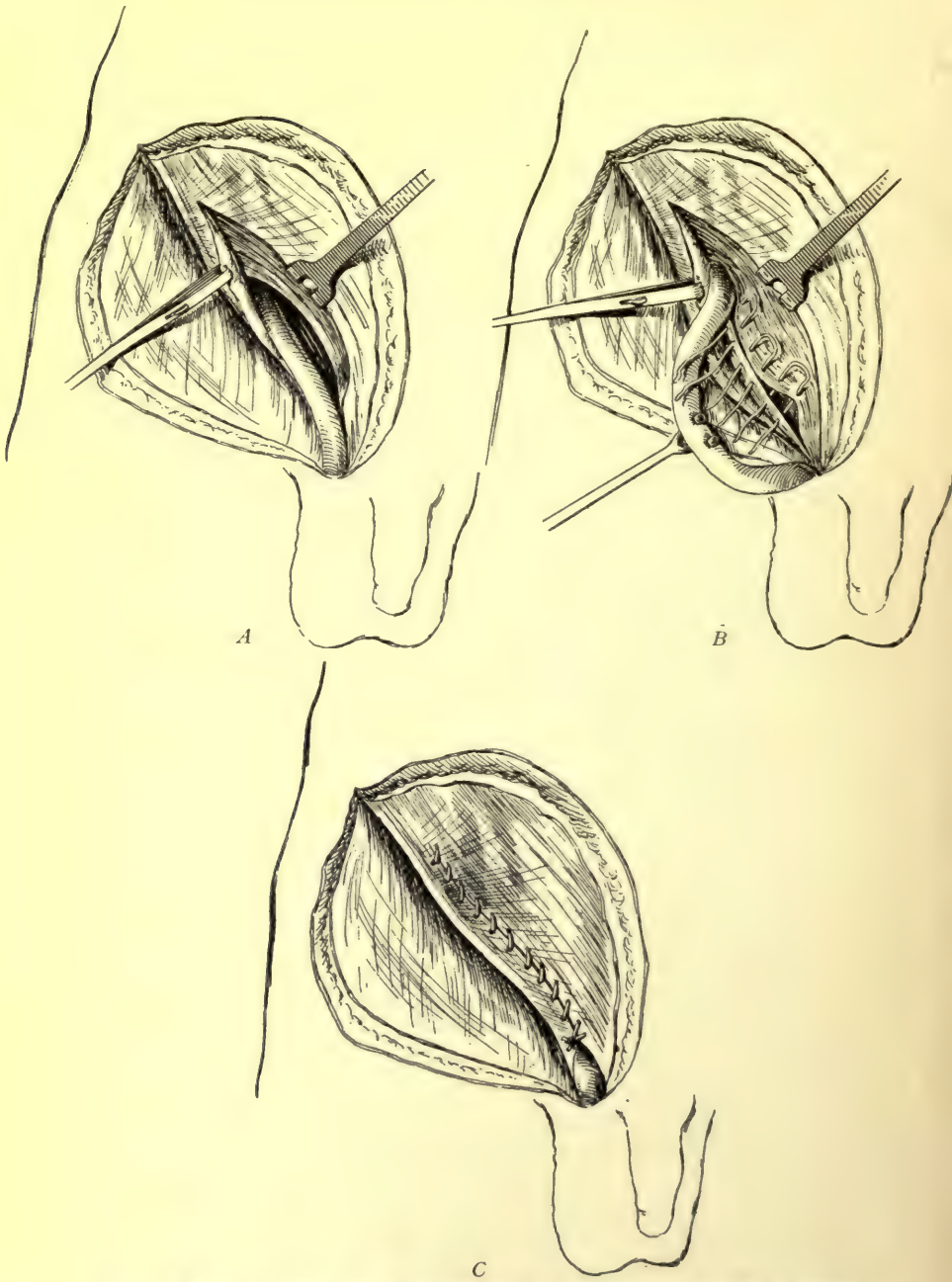

FIG. 165.—BASSINI'S RADICAL CURE OF INGUINAL HERNIA. The three chief stages of the operation are illustrated. In *A* the external oblique has been slit up to expose the internal ring fully. In *B* the cord is hooked down out of the way and the lower edge of the internal ring is approximated behind it to Poupart's ligament, leaving just room enough for the cord to emerge at the outer end. In *C* the cord has been laid down in position and the cut edges of the external oblique sutured together over it, leaving just room for its emergence below.

interfere with the muscles at all. In adults with small herniæ and strong muscles we often leave the muscles alone ; in older people, or in those in whom the canal is dilated and the muscles feeble, we prefer the operation described below.

Fairly thick catgut is a good material for ligaturing the neck of the sac, while silk or catgut may be used to bring the walls of the canal together, but we do not think that the material employed for the sutures is of great importance. The probability is that the stitches in the canal soon cut through, but in the meantime adhesion occurs between the adjacent surfaces of the internal and external oblique muscles and this keeps the parts in position subsequently.

Operation.—The following are the steps of the operation which we perform for radical cure of an oblique inguinal hernia in an adult. The thigh is flexed and abducted, and the parts shaved and disinfected in the usual manner ; the male genitals should be covered with sterilised towels and kept out of the way. A curved incision with its convexity upwards is made just over Poupart's ligament, the lower end being near the symphysis pubis and the upper above and outside the centre of the ligament ; in this way a flap is formed, and the line of incision in the skin does not correspond to the line of suture of the muscles ; the curve should be a large one so as to expose the whole of the parts concerned well above and outside the internal ring (see Fig. 166). The incision is deepened until the external oblique is exposed, when the flap is peeled well down. The cord is hooked up by the finger so as to make the coverings tense, and the intercolumnar fascia is divided at its attachment to the margins of the external ring, and the external oblique separated from the cord and the internal oblique by sweeping first the handle of the knife and then the finger between the two structures. The external oblique aponeurosis is then split up beyond the internal abdominal ring.

A longitudinal incision is now made through the coverings of the cord, its constituents are spread out, and the sac (which forms a whitish band running down in front of the vas) is identified. The lower edge of the sac is most readily recognised, and, when this is found, the fascial structures are divided down to it, its margin is seized in a pair of Spencer Wells's forceps, and it is stripped up from the cord. The assistant takes charge of the vas and the other constituents of the cord. When the neck of the sac has been cleared, the finger is pushed up between the peritoneum and the abdominal muscles so as to form a bed into which the sac or its stump will be received. The sac is now transfixed, ligatured, and cut away below the ligature ; the ends of the ligature are then brought through the abdominal muscles in the manner described on p. 484 and tied so as to fasten the neck of the sac to the inner aspect of the parietes about an inch above and to the outer side of the internal ring. In other cases the sac is twisted in the manner described on p. 485.

After the sac has been disposed of in one of these ways. the repair of

the canal is undertaken if necessary. In some cases we simply stitch up the external oblique tendon and narrow the external ring, leaving just sufficient room for the cord to pass (see Fig. 165, *C*). In other cases we adopt measures to narrow the canal, as above described, by mattress sutures. When we employ mattress sutures we pass one end of the stitch beneath Poupart's ligament and one through it, and thus obtain a stronger hold. It is most important to see that nothing but the conjoined tendon is taken up when passing the innermost sutures; the bladder has been perforated by the suture when the posterior surface

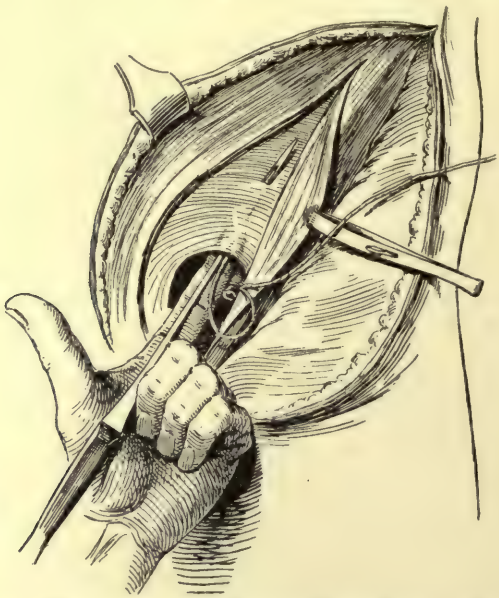

FIG. 166.—METHOD OF DEALING WITH THE NECK OF THE SAC AFTER LIGATURE. The ends of the ligatures upon the neck of the sac are threaded in turn upon a nævus needle and carried through the abdominal wall as shown in the figure. When the two threads, which are brought out close together, are tied, the neck of the sac is drawn up well above and to the outer side of the internal ring (see also Fig. 162).

of the conjoined tendon has been imperfectly cleared. The external oblique is then united by interrupted sutures, the external ring being diminished in size to any required extent.

All bleeding points are now secured by ligature, and the flap is stitched up with a continuous suture. In very fat subjects we put a small drainage tube in the upper angle of the wound for two days; in the great majority no drain is necessary. The bandage is a double spica. If the dressing becomes soiled or there is much bleeding, the dressing must be changed next day, otherwise it need not be disturbed for a week unless a drainage tube has been inserted; in that case the tube is left out on the second day. To prevent the dressing being soiled with urine in the male, we take

a piece of jaconet with a hole in it for the penis, and fasten it over the lower edge of the dressing so that any urine is caught by it; this need only be applied while the patient micturates. In many cases it suffices to fix on a small dressing with collodion, but it is well also to put on a spica bandage so as to support the parts should the patient be sick, or cough, or strain. A saline purge is given at the end of the second day.

We usually keep our patients in bed for three weeks after the operation, and for the first few days after they are up they feel more comfortable if they have the support of a firm calico or elastic bandage over a pad of wool, but this should be given up in a week or two. No truss or support of any kind should be worn after the operation; we consider this an important point. Support is unnecessary, unless the patient has a bad cough, when an elastic spica is preferable to a truss—the pressure of a truss, however light, leads to softening and thinning of the cicatricial tissue and so to failure of the operation. When, however, the operation has been done simply to effect the reduction of the hernia with the view of enabling the patient to wear a truss the case is different.

In infants and children so young that they do not have perfect control over the excreta, we adopt the plan advocated by Mr. H. J. Stiles (see *British Medical Journal*, 1904, vol. ii. p. 812), which answers admirably. No dressing is used; if there is any oozing, the wound is dusted over with powdered boric acid. The child is kept lying on his back in the cot, and is fastened down by a yoke around the thorax and a bandage running from each ankle to the foot of the cot; the latter is sufficiently loose to allow the legs a little play. A large low cradle is put over the child, and a towel is hung across the cradle (see Fig. 167); when the child passes water, the urine is projected forward clear of the wound and is received upon the towel, which is changed as often as may be necessary. There is no risk of soiling the wound as there would be were the usual dressings employed. The child wears no night clothes—or at most a short vest—and there is no blanket over the body beneath the cradle. Interference with the wound by means of the child's hands is prevented either by fastening the blanket over the cradle to the undersheet and the use of the restraining yoke, or by tying the hands. We have used this plan in many cases with invariable success, and we are confident that it is superior to that in which dressings are employed.

Complications.—The most important complication is suppuration, which is generally attributed to faulty disinfection of the deep stitches. This may be so, but in our opinion it is more often due to incomplete disinfection of the skin or to faulty manipulation on the part of the surgeon or his assistants. However that may be, suppuration after an operation for radical cure interferes very seriously with the result of the operation. Separation of the stitches takes place in practically all cases in which suppuration occurs, and the wound does not heal until this has happened; as this may take a long time, the inguinal canal becomes

infiltrated with inflammatory cells and converted into cicatricial tissue which gradually yields before the weight of the abdominal contents.

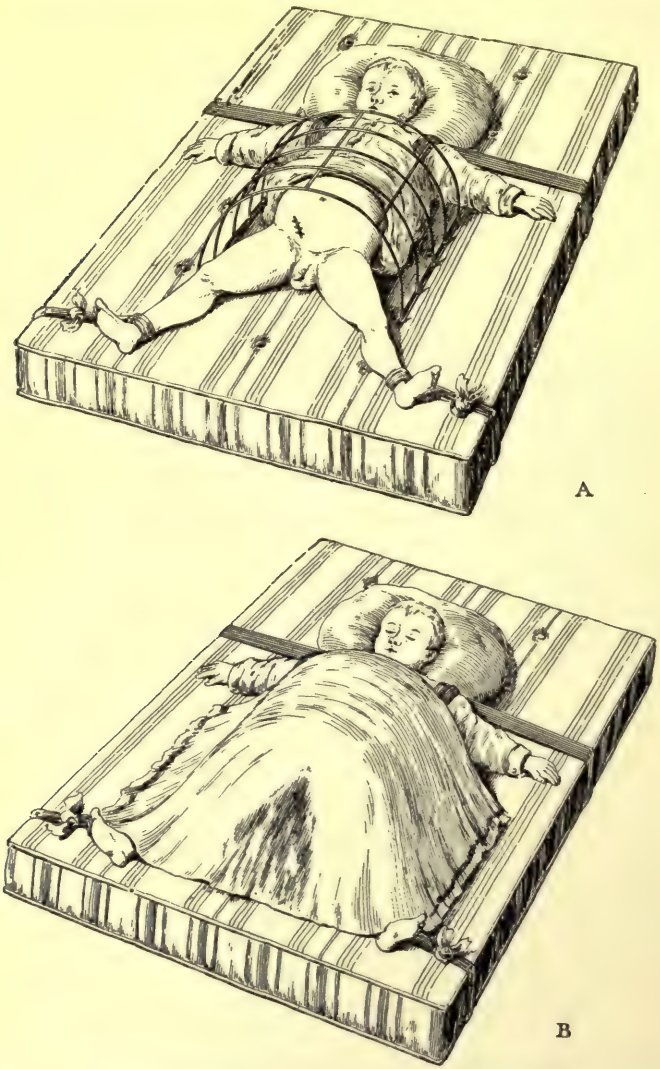

FIG. 167.—STILES'S METHOD OF AFTER-TREATMENT FOR CASES OF RADICAL CURE OF INGUINAL HERNIA IN YOUNG CHILDREN. No dressings are used. The child lies beneath a cradle, the shoulders and ankles fastened as shown in A. Over the cradle is laid a small sheet—as in B—and against this the urine is projected when the child passes water. A drawsheet and mackintosh are placed beneath the child.

Hence the sooner the septic stitches are removed the better. We would therefore advise that, when the accident occurs, the wound should be opened up, either by turning aside the original flap or by a second smaller

incision over Poupart's ligament, so as to expose the lower end of the deep stitches, which are then removed ; in this way much time is saved.

It sometimes happens that a small vesicle forms in the scar long after the wound has healed and the patient has been about, and leaves a sinus leading down to a stitch ; this has happened even many months after the operation, and the sinus will not heal until the stitch concerned has escaped or has been removed. The cause of this is not quite clear. Fortunately—in our experience, at any rate—this is an excessively rare occurrence and need not be taken into consideration.

CONGENITAL REDUCIBLE INGUINAL HERNIA.

Two conditions may be met with : in one the testicle is in its normal position and there is a patent canal from the abdomen to the bottom of the tunica vaginalis, and in the other the testicle is only partially descended. The so-called ' infantile hernia ' does not complicate the operation for radical cure ; it simply means that the surgeon has to perform an operation for hydrocele as well as for hernia.

Treatment when the testicle is in the scrotum.—We have already referred to the use of *trusses* for these cases (see p. 481). The early steps of the *radical cure* are similar to those for ordinary oblique inguinal hernia (see p. 489) up to the division of the external spermatic fascia. The funicular process, which appears as a white band lying among the structures of the cord, should be defined and divested of the surrounding fascia. In order to make sure of its nature a small incision should be made into it, and its interior explored by a probe or with the finger for a communication with the abdomen. In these cases the vas is much more intimately connected with the wall of the sac and is more difficult to separate than in the ordinary form of inguinal hernia, and care must be taken not to injure it as it is very fragile in children. The best plan is to strip the structures off the sac with a fine dissector until the latter can be pushed between the vas and the wall of the sac ; then it is easy to strip the sac off.

The funicular process should be cleared and divided just above the testicle, which is readily pulled up out of the scrotum during the manipulations, so that there is no necessity for extending the incision downwards. We always leave the lower end of the process open. The rest of the operation is similar to that already described for an ordinary radical cure (see p. 489).

Treatment when there is imperfect descent of the testicle.—Here the operation is more difficult, as, in addition to the radical cure of the hernia, the testicle must be brought into its natural position in the scrotum. When this is found impossible, the operation is much simplified by castration ; but the testicle may be brought into the scrotum in many cases (see Vol. V.). The radical cure of the hernia is in all essentials

similar to that just described, but extra care must be taken not to injure the vas, which will be found on the outer wall of the sac; it is very tortuous towards the lower end, and is very apt to be divided in cutting off the sac close to the testicle unless great care is taken to trace it to its origin.

DIRECT REDUCIBLE INGUINAL HERNIA.

The operation for radical cure is more difficult and the results less satisfactory in this form of hernia than in the oblique one. The sac comes down internal to the deep epigastric artery, either pushing the conjoined tendon before it or passing through an opening in it. These cases usually occur in oldish people, and the neck of the sac is so broad that it cannot be closed by twisting or ligature. It should be carefully cleared and inspected to see that it is not adherent to the bladder. The sac is then opened, its contents returned, the sac cut away, and the peritoneal cavity closed by a continuous catgut suture.

It is necessary to close the inguinal canal in these cases, and possibly this is best done by Halsted's method of bringing the cord direct through the abdominal wall; this enables the posterior wall of the canal and the external oblique to be brought together over the whole region (see p. 487). In a good many cases the scar bulges subsequently and the patient may have to wear a truss, but this should not be commenced until bulging has actually taken place; we have had a number of cases in which no truss has been necessary.

INTERSTITIAL HERNIA.

Here the sac passes upwards behind or between the abdominal muscles. In some cases the sac turns up at the internal ring, and lies entirely in the substance of or behind the abdominal wall; in others it has two projections, one extending downwards along the canal and forming a bubonocele, while the other runs up in front of the peritoneum as a diverticulum from the neck.

Radical cure is urgently called for in these cases, because the neck of the sac is bent and strangulation is very apt to occur. A truss is inadvisable because it is not easy to be sure that all the contents have been returned into the abdomen before it is applied.

The operation is practically identical with that described on p. 489. When there is no bulging in the inguinal canal the sac will be found projecting upwards behind the abdominal wall, and must be pulled down and treated in the usual manner (see p. 484). When part of the sac is in the inguinal canal, the operation is easier, because the diverticulum behind the muscles becomes exposed as the main sac is cleared.

IRREDUCIBLE INGUINAL HERNIA.

In these cases it is always advisable to slit up the external oblique so as to have the entire sac exposed to view ; all oozing points should be tied at once. The sac is opened, and the separation of the contents proceeds until the omentum is freed and it is possible to pull down healthy omentum in all directions. If the omentum is not much thickened, it can be returned into the abdomen, and the subsequent proceedings are similar to those described on p. 489. In long-standing cases, however, the omentum is so much altered that its return is difficult and inadvisable, and therefore, after all the adhesions have been divided, the omentum is pulled down until the normal portion is seen ; this is ligatured in sections (see Fig. 115), care being taken not to remove it nearer to the colon than one inch. The stump is then returned into the abdomen, and the finger is pushed up after it in order to make sure that the stump is clear of the internal ring, otherwise adhesions may form there and inconvenience the patient afterwards. When the intestine or other structures are adherent to the sac the lines laid down on p. 474 must be followed. When the neck of the sac has been torn in separating the adhesions it must be ligatured, if that is possible, or cut clean away and the edges of the peritoneum united by a continuous suture. In these cases it is always necessary to repair the canal, and this should be done by Bassini's method (see p. 487).

In the treatment of *obstructed, inflamed*, or *strangulated* oblique inguinal hernia, there is nothing to add to what has been said in Chap. XXIX. When taxis is performed for inguinal hernia the thigh should be flexed to a right angle and rotated inwards ; full details are given on p. 483.

Instructions are generally given to divide the neck of the sac or the internal ring directly upwards in cases of strangulated hernia. No doubt it is very important to bear in mind the relation of the deep epigastric artery to the neck of the sac, but we always slit up the external oblique in all cases of strangulated hernia and so we have the neck of the sac freely exposed, and this obviates all risk of injuring the vessel wherever it may be. Moreover, we have never found it necessary to divide the muscles ; we have always found the stricture in the neck of the sac itself, and division of the latter, followed by stretching the ring with the fingers, has always rendered reduction easy.

FEMORAL HERNIA.

This form of hernia descends through the femoral canal on the inner side of the femoral vein and pushes before it the sub-peritoneal fascia the septum crurale, the sheath of the femoral vessels, and the cribriform fascia. These structures are seldom sharply marked off from one another, and there is often much fat among them, so that the sac may lie in the midst of a projecting fatty mass and may be difficult to find, especially

when it is empty. After emerging from the saphenous opening the hernia, as it enlarges, travels upwards towards Poupart's ligament and outwards over the femoral vessels; this is an important point to bear in mind in attempting reduction.

Femoral hernia generally occurs in adults, and is very rare before puberty. It is most common in women, and is indeed the commonest form of hernia in adult females. When it becomes strangulated, the constriction is usually in the neck of the sac; but in a large and much distended hernia the neck is pressed firmly against the edge of Gimbernat's ligament, and mere division of the former will not always permit the reduction of the hernia. The pressure against the sharp edge of Gimbernat's ligament injures the neck of the hernia so severely that gangrene is more common and occurs earlier than in other forms of strangulated hernia.

REDUCIBLE AND SIMPLE IRREDUCIBLE FEMORAL HERNIA.

The hernia may be reducible or irreducible, and of the latter there are the various forms already spoken of on p. 461. The treatment of the reducible form is either by truss or by operation. In simple irreducible hernia a truss often causes so much pain that operative interference becomes imperative.

Trusses.—The truss employed in femoral hernia resembles that used for the inguinal variety, except that the pad is bent at a more acute angle to the spring and that there is no perineal band. The measurements which should be sent to the instrument-maker are the same as for inguinal hernia, except that the saphenous opening should form the starting-point and termination of the pelvic measurement, instead of the external abdominal ring. Nothing need be added to the remarks made on p. 482 concerning the management and application of the truss. In reducing the hernia the thigh should be flexed and strongly rotated inwards, the neck of the sac drawn directly downwards, and pressure exerted upon the hernia, at first downwards and inwards, and finally directly upwards.

Radical cure.—The radical cure of femoral hernia is not nearly so satisfactory as that of the inguinal form; but at the same time in patients who lead an active life it is best to perform it, as they often suffer much pain from the truss, while the hernia is almost always irreducible and the radical cure will, at any rate, allow the truss to be applied without any pain or risk of injury to the sac or its contents.

Besides obliterating the neck of the sac, it is necessary to do something to reduce the size of the femoral canal, otherwise recurrence almost invariably takes place. Unlike the inguinal canal, the femoral is not bounded by active muscular fibres which close it every time the muscles contract, but is a rigid tube surrounded by fibrous tissue.

In order to deal with the canal, various methods have been introduced, which may be grouped into three classes according to their guiding principle. In the first, the lower end of the canal is closed by occluding the saphenous opening; in the second, the canal is mechanically plugged, for example, by a flap of pectineus muscle and fascia; and in the third, the canal is occluded at its upper end—*i.e.* on its intra-abdominal aspect.

An attempt should be made to close the canal as a whole and this may be carried out either by Roux's original method or by some modification of it

In *Roux's method*, small steel staples are used to fix Poupart's ligament down to the ilio-pectineal line. After the sac has been ligatured and stitched up to the abdominal wall, a finger is introduced into the crural canal and a staple is thrust through Poupart's ligament, and, guided by the finger in the canal, is fixed against the ilio-pectineal line. The staple is then driven firmly home by means of a staple-punch and a hammer, and Poupart's ligament is thus firmly attached to the front aspect of the bone and the canal thereby closed. Good results have been obtained by this method, but occasionally the staples have become loose and have had to be removed. They should be driven firmly home and should not be too large.

Roux's principle may be carried out more safely without the use of staples, by suturing Poupart's ligament to the back of the horizontal ramus of the pubes. This is done as follows. After the sac has been dealt with, the fat and fascia are pushed inwards and downwards from the surface of the pectineus muscle and the fibres of this muscle are detached from the middle third of their attachment to the pubes. The bone thus exposed is now drilled in two places, upwards and backwards, about three-quarters of an inch apart, the point of the drill being inserted about half an inch below the upper margin of the bone. The tissues on the deep surface are protected by the finger—which can feel the drill before it actually emerges from the bone—or by a copper spatula inserted through the enlarged femoral canal. A piece of fine silver wire about eighteen inches long is now folded in half so as to make a loop, which is pushed through the drill-hole and the loop hooked up through the femoral ring into the wound. A stout silk suture threaded on a fully curved needle is passed through the front of Poupart's ligament about half an inch above the upper boundary of the crural canal. The end of this thread is then passed through the loop in the silver wire and drawn through the bone from within outwards. A similar loop of silver wire is next passed through the second hole in the bone, and the other end of the silk suture is then passed through Poupart's ligament, about three-quarters of an inch farther out, and drawn through the bone in a similar manner. This makes a stout mattress suture, which when tightened, draws Poupart's ligament down to the back of the horizontal ramus of the pubes and satisfactorily obliterates

the femoral canal. It may be strengthened by a few silk stitches between Poupart's ligament and the periosteum.

STRANGULATED FEMORAL HERNIA.

The operation for strangulated femoral hernia is essentially the same as for the inguinal form (see p. 472); but here it is seldom possible to reduce the bowel without partially dividing Gimbernat's ligament, and this should be done in the inward and upward direction.

When the bowel is gangrenous and requires excision, this is better done from a fresh abdominal incision than from the wound in the thigh. It is very difficult to bring down enough of the gut through the crural canal to allow proper manipulations to be carried out. The original skin incision should be prolonged upwards, the rectus muscle pulled inwards, a vertical incision made behind it, and the intestine exposed as it enters the crural canal. The strangulated loop can then be drawn out of the abdomen through this opening, but care must be taken to cover the surface of the wound with gauze pads so as not to soil the wound in drawing the hernia out. It is usually easier to pull the hernia out from above than to push it back from below.

Femoral hernia rapidly becomes gangrenous when strangulated, and in some cases, when the patient is very ill and the gangrene complete, it may be best merely to open the bowel and form an artificial anus, which is closed afterwards (see p. 507) ; but if the patient's condition is good, an attempt should be made to restore the continuity of the intestine at once.

UMBILICAL HERNIA.

Umbilical hernia is a protrusion of some of the abdominal contents through the umbilicus or through an opening in its immediate vicinity. In infants the protrusion is directly through the umbilicus. In adults the hernia is generally supposed to pass out through the space through which the umbilical vein originally passed ; some surgeons, however, hold that the opening is really in the abdominal wall above the exit of the cord. The coverings of an umbilical hernia are sub-peritoneal fat, fascia, and skin. The sac always contains omentum, usually with a portion of the colon and sometimes also with small intestine.

In the herniæ of adults there are almost invariably adhesions between the contents and the sac, the omentum especially being often very adherent. Intestine may also be adherent to the sac wall or to the omentum, and the separation of the various constituents of an irreducible umbilical hernia is often a matter of extreme difficulty. These herniæ are very liable to become the seat of obstruction or strangulation ; the strangulation occurs either at the point of exit through the abdominal wall or beneath bands or through holes in the omentum. The latter

point should be borne in mind, and in strangulated cases the surgeon should not be content with reducing the contents of the sac as a whole ; they must be opened out to see whether there is strangulation within the omentum. The omentum is usually much thickened, either by deposit of fat or by inflammatory exudation, and it is often impossible to return the greater part of it into the abdominal cavity. There is usually a good deal of separation of the recti in these cases.

It will be best to consider the treatment (*a*) in infants and young children, (*b*) in adults, and (*c*) in old age.

Treatment in young children.—Here the protrusion is usually through the true umbilical opening, and, unless the case is neglected, it seldom attains any great size ; if the hernia is well looked after, there is a strong tendency to closure of the opening without operative interference.

Trusses.—The hernia is generally noticed soon after birth, and an efficient truss should be applied at once. During the early period, the best arrangement is to fix a pad over the umbilicus ; this pad should be quite flat and without any knob projecting into the opening. A pad with a projecting knob will retain the hernia, but it prevents the closure of the opening. In infants, home-made pads are quite sufficient. A penny, or a flat piece of block-tin about the size of half a crown, is covered first with strapping and then with linen ; the child is laid on its back, the sides of the abdomen are compressed so as to push forward the opening, a piece of boric lint is placed over the umbilicus, and the pad applied, and kept in position by means of an elastic binder. Great care must be taken in the management of these pads. The skin must be kept dry ; fresh pads and lint should be applied when there is the least sign of soiling, and in any case once a day. If this treatment is carried out assiduously, the opening will gradually close and the hernia will be cured in the majority of cases. In older children it is sometimes more convenient to have a flat pad made of vulcanite sewn in an elastic abdominal belt.

Radical cure.—If it is found that the opening does not close in spite of the prolonged use of retentive apparatus, operative measures may be required, and are usually quite satisfactory in young children ; there is no excess of fat, the opening is small, and its sides are easily brought together. The skin over the hernia is usually thick, and should be turned aside as a flap, so as to carry the line of suture in the skin away from that in the deeper parts. When the sac of the hernia is exposed it should be opened to see that none of the contents are adherent ; when it has been cleared it is cut away, and the peritoneal edges sewn up by a continuous purse-string suture of catgut. The opening in the abdominal wall is then closed in two layers by lifting up the edge of the opening and splitting the fibrous wall horizontally ; each layer is sutured separately, and mattress sutures are applied through both layers so as to give extra

support (see Fig. 168). The line of union should be transverse to the long axis of the body. After the dressing has been applied, the abdomen is supported by a binder. It is well to keep the patient in bed for about four weeks so as to allow the union to become firm; during that period a stout binder is used, and for some months afterwards the patient should wear a suitable abdominal belt without any pad over the hernial orifice.

Treatment in adults.—Umbilical hernia is most common in women during and after the child-bearing period, and may be reducible or irreducible. In the latter case there is often much

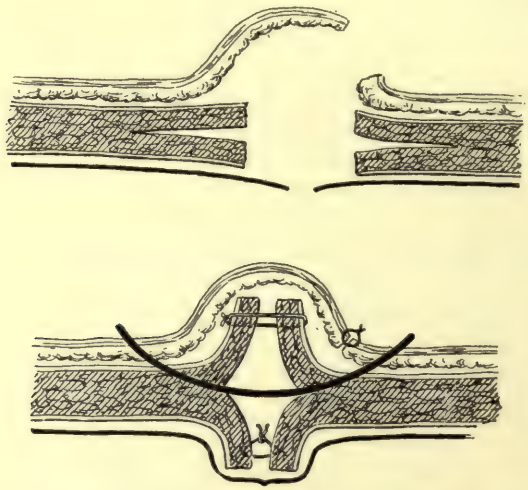

FIG. 168.—RADICAL CURE OF UMBILICAL HERNIA IN A YOUNG SUBJECT. The upper sketch shows the method of splitting the abdominal wall horizontally, while the lower one shows the two layers thus formed sutured separately; a stout mattress suture runs through the angles of the flaps on each side. The peritoneum and skin are sutured separately. It is the fibrous wall that is split; the recti are untouched.

discomfort from adhesions of the omentum, which anchor the transverse colon and in some cases pull upon the stomach; for this reason alone it may be necessary to perform a radical operation. The result of the operation is not nearly so satisfactory as in inguinal hernia, and the union may become stretched, especially if the patient becomes pregnant. Hence radical cure should not be urged in young women unless the hernia is irreducible and causes much discomfort; as long as the hernia is small and reducible, a truss should be employed, consisting of a flat pad embedded in a firm elastic abdominal belt of large size and fitted with perineal straps. It is unlikely that actual cure will occur in adults; but as long as the hernia does not increase in size and complications do not arise, this apparatus will suffice. Should, however, the hernia increase in size and cause much discomfort, or should it become irreducible or obstructed,

a radical cure should be performed, unless some strong contra-indication is present.

The best subjects for radical cure are spare people with strong abdominal walls ; it is not so satisfactory in fat persons with lax abdominal walls, but it enables them to wear a suitable support. The radical cure in an adult with a fair-sized hernia and with considerable separation of the recti, is done as follows :—

A large elliptical vertical incision, including the thin redundant skin and the umbilicus, is employed. This incision should be made so that the long axis of the ellipse lies parallel to, but on one side of, the middle line ; the cicatrix will then not correspond with that in the deeper parts when the edges are stitched together. In fat people with a pendulous abdomen, it is well to extend the incision tranversely on each side from the centre of the elliptical one, and to remove some of the subcutaneous fat, undermining the flaps, especially the lower one, for this purpose. The sac is then freed, its neck is defined all round the opening in the abdominal wall, and the sac itself incised at some point where there are few or no adhesions. The adhesions in the interior are now separated by the finger, and, when the bowel has been returned, it is well to ligature and remove the greater part of the omentum and return the stump into the abdomen. It is generally impossible to keep the sac entire, and the question arises how to deal with it, as it cannot be twisted or ligatured satisfactorily. Attempts to separate the peritoneum from the sides of the opening and to unite it by a continuous suture are unsatisfactory, as there is a good deal of tension and the peritoneum is certain to tear. In our opinion it is better not to attempt this ; according to the size of the opening, we pass two or three mattress sutures through the muscles and peritoneum wall from above downwards, and these bring the edges of the opening together transversely without difficulty as they take a firm hold on the fibrous walls. These sutures bring the peritoneal surfaces on opposite sides of the ring into apposition, and then a continuous suture should be made to unite the superficial edges of the ring which project forwards. Although this secures good approximation at the time, the cicatrix is apt to yield later on, and two plans have been introduced to strengthen the parts.

A good plan is to insert a support of silver wire.[1] This may either be made by interlacing silver-wire sutures in various directions, or preferably, a ready-made silver filigree (see Fig. 169) may be fixed over the opening. The hernia is dealt with in the usual manner, and the peritoneum is sewn up with catgut. A plate of silver filigree, much larger than the opening, is now placed on the outer surface of the subperitoneal tissues, the muscles being raised sufficiently to enable its edge to be fixed firmly beneath them. The edge of the plate is then fixed

[1] See Willy Meyer, *Annals of Surgery*, vol. xxxi., 1902.

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all round with a fine suture, the edges of the umbilical opening are brought together as closely as possible, and the wound is stitched up. Should the fibrous tissues be much atrophied, the plate may be laid over the anterior surface of the muscular wall, the important point being

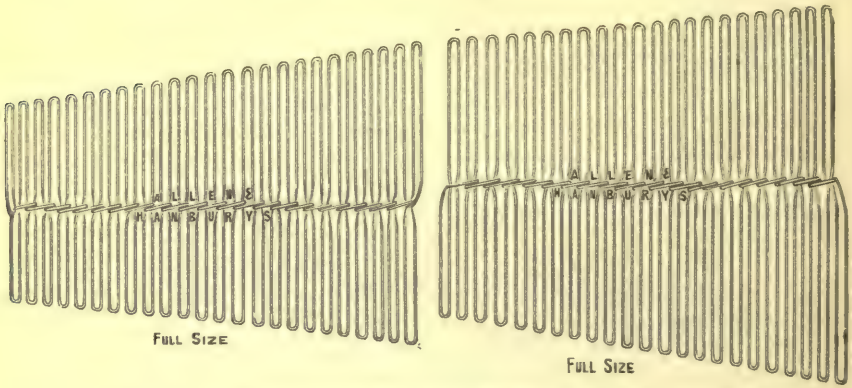


FIG. 169.—McGAVIN'S SILVER FILIGREES FOR HERNIA. These may be of any size or shape. Those shown above are best suited for large inguinal or ventral herniæ; those used for umbilical hernia are often elliptical in outline.

to see that its edges are firmly fixed all round. After the operation, the patient should be kept in bed for six weeks, and should wear a firm abdominal belt without any pad unless there is a tendency to fresh protrusion.

Gersuny advocates bringing the recti muscles back into their normal position in the middle line. The sheath of the rectus is opened on each side, and the recti are separated and brought inwards to the middle line and their adjacent edges are sewn together. In order to do this satisfactorily it is necessary to separate also the transverse fibrous bands in the rectus above and below the umbilicus, and therefore the incision must be free, and in bad cases may have to extend nearly from the xiphoid cartilage to the pubes. This operation is often a severe one, and may be impossible in feeble and very fat persons. In comparatively spare subjects, on the other hand, it is not particularly severe, and we have done it on several occasions with satisfactory results.

Treatment in old age.—Here the hernia is practically always irreducible and usually very large, and the feeble musculature, the excess of fat, the size of the opening, and the generally weak state of the patient preclude any attempt at such a radical cure as Gersuny's. The contents are usually inextricably mixed up and must be separated, which takes a long time, and the patient is unable to undergo the further prolongation of the operation and the loss of blood which is involved in bringing the recti together. The filigree method may, however, be employed. A suitable belt must be worn after the operation; indeed,

in some cases, it will be best to employ a truss moulded to the shape of the hernia in preference to an operation.

When these herniæ become strangulated, the patient's condition is grave. The strangulation is difficult to relieve, and the patient is not in a state to stand a prolonged operation. Further, it is often difficult to discover the seat of the strangulation; frequently it is due to mere kinking, as when a full loop of intestine is acutely kinked over the lower edge of the umbilical opening. The sac must be opened up freely and the structures separated until the cause of strangulation is found and relieved; the opening is then dealt with in the manner above described. The great danger of strangulated herniæ and the difficulty of keeping up the hernia in old people are strong arguments in favour of an attempt at radical cure in younger subjects, even if its result is only to enable the patient to retain the hernia by a belt.

VENTRAL HERNIA.

Under this heading we include herniæ which pass out at other points in the anterior abdominal wall than those already enumerated. Ventral hernia may occur with or without previous injury, and one of the most common causes is a laparotomy, especially after a lateral incision—*e.g.* draining an appendicitic abscess. In other cases hernia may follow rupture of muscles. The shape of the neck of the sac differs; sometimes the hernia comes through a small opening, such as that left by a drainage tube, in other cases there is a much larger weak area, as after a free abdominal incision, and there is no regular neck to the sac.

Treatment.—Unless a well-fitting and comfortable abdominal belt keeps back the protrusion easily, an attempt should be made to repair the hernia. The hernial sac is freed, its contents returned into the abdomen, the sac excised, and the peritoneum stitched up. The cicatricial edges of the opening in the abdominal wall are then cut away, and the various muscular layers are approximated separately by silk mattress sutures; the approximation is completed by a continuous suture between the opposed surfaces.

The operation may be difficult because the viscera may adhere to the cicatrix, and it will then be best to excise the edges of the hernial opening and open the peritoneum at a little distance from the sac at a point where there are no adhesions; if there is much difficulty in separating adhesions, a good plan is to divide the peritoneum all round the adherent point and to return the intestine covered with the peritoneum into the abdomen and then to approximate the abdominal walls (*vide supra*). Should the hernia be large and the edges of the opening difficult to approximate, a silver filigree (see p. 501) may be required.

LUMBAR HERNIA.

This occurs in the triangle of Petit, which is formed by the iliac crest below, the latissimus dorsi on the inner and the external oblique on the outer side. The abdominal wall is weak at this spot and violent strains may cause a hernial protrusion.

Treatment.—The best treatment is to provide support either by a truss with a large pad and a perineal strap to prevent it from slipping up, or by firmly fitting corsets with a suitable pad; the latter are often the more satisfactory. If the apparatus does not control the hernia or if it causes pain—as it often does from pressure on the crest of the ilium—it may be advisable to perform an operation much on the same lines as for ventral hernia (*vide supra*).

EXCESSIVE SEPARATION OF THE RECTI.

It is not uncommon in women, as the result of repeated pregnancies, for the recti to become widely separated and to allow a marked bulging of the whole centre of the abdominal wall. As a rule a well-fitting belt suffices; but if a radical operation seems to be advisable, closure may be

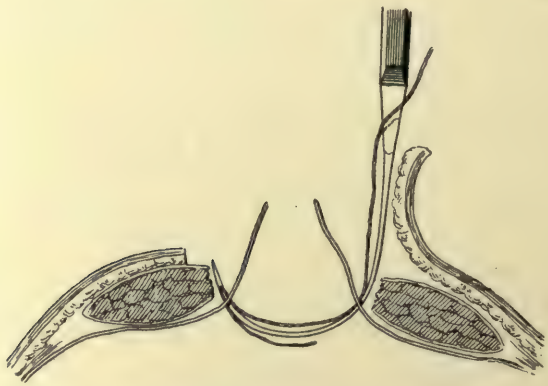


FIG. 170.—METHOD OF OPERATING FOR UNDUE SEPARATION OF THE RECTI. The inner edge of the rectus on each side is denuded of its sheath and the redundant peritoneum is cut away after a series of sutures have been inserted in the manner shown above. Then through-and-through sutures are inserted in the abdominal wall.

effected by making an incision a little to one side of the middle line, removing the fibrous tissue between the recti, bringing them together by stitches, and inserting mattress sutures through the entire thickness of the abdominal wall, as shown in the diagram (see Fig. 170). The through-and-through sutures are tied after the skin has been stitched up.

OBTURATOR HERNIA.

This is a rare form of hernia, which passes through the obturator canal and descends downwards and forwards along the outer part of the horizontal ramus of the pubis. The sac usually comes through the anterior part of the fascia over the obturator opening, and may pass either beneath the obturator externus, or over it, and beneath the pectineus and the adductor longus ; the obturator nerve and artery are usually to the outer side of the neck of the sac. The hernia, unless large, is rarely noticeable in the thigh, and in the strangulated form the nature of the case may only be discovered after the abdomen has been opened for acute intestinal obstruction ; pain along the obturator nerve and tenderness in the groin are generally present. The hernia is very tightly nipped, and, in most cases, the intestine has been found to be gangrenous.

Treatment.—If an obturator hernia is diagnosed, the only treatment is by operation, because a truss cannot be satisfactorily applied.

The best way of dealing with these cases is to perform a median sub-umbilical laparotomy with the patient in the Trendelenburg position ; and in addition, to make a vertical incision four or five inches long over the inner border of the pectineus, separating that muscle from the adductor longus in order to expose the obturator foramen. An attempt is made to remove the sac, partly from the thigh wound and partly from the abdomen. If this is impossible, its neck should be divided between ligatures and the stump pushed up from below.

In strangulated cases recovery has followed pulling up the gangrenous intestine through a median laparotomy opening, resecting the gangrenous portion and anastomosing the ends of the intestine. If it is necessary to enlarge the obturator foramen this is most safely done by cutting inwards.

CHAPTER XXXI.

FÆCAL FISTULA AND ARTIFICIAL ANUS.

THE term 'fæcal fistula' is applied to those communications between the interior of the intestinal canal and the surface, in which there is no obstruction to the passage of fæces along the bowel and in which, therefore, only a small portion of the contents escape through the opening, while the larger part, and at times all, passes on along the ordinary route. The term 'artificial anus,' on the other hand, is limited to the cases in which there is a distinct obstacle to the onward passage of the fæcal contents and in which they all, or almost all, escape through the external opening.

FÆCAL FISTULA.

This condition may arise either from disease of the intestine or from operative procedures, and the opening in the intestine may be immediately adherent to the abdominal wall, or may lead into a cavity in the interior of the abdomen which again communicates with the surface by a sinus. The latter condition is not uncommonly met with after abdominal suppuration, especially in connection with the appendix. A fæcal fistula may also originate in connection with malignant disease of the intestine; in that case, perforation takes place and an abscess forms and discharges externally. Fæcal fistula may follow rents of the peritoneal coat in operating on cases of tuberculous peritonitis (see p. 450), it may result from accidental wounds of the bowel in operations such as the removal of adherent ovarian cysts, or the surgeon may deliberately establish a fæcal fistula, as when an artificial opening is made into the cæcum. 'Congenital fæcal fistula' is referred to on p. 369; these are usually, however, cases of artificial anus because all the intestinal contents are discharged through the opening owing to the small calibre of the intestine below.

TREATMENT.—A considerable number of fæcal fistulæ close spontaneously under suitable non-operative treatment—at any rate, when the opening in the bowel is not immediately adherent to the skin. In fæcal

fistula following an abscess there need be no hurry to perform a plastic operation ; the fistula will generally close spontaneously, provided that there is no obstacle to the escape of discharges from the sinus. It is of the highest importance to provide free drainage from the sinus, and if necessary the skin wound must be opened up and the cavity packed or drained so as to make it granulate from the bottom. The bowels should be kept well open and a non-irritating and digestible diet, such as one consisting of milk and farinaceous food, fish and pounded meat, should be ordered. The patient should be kept in bed for a time, but if the discharge is slight he may be allowed to walk about. Under this treatment closure often takes place either by cicatrisation of the opening or perhaps more commonly by its adhesion to a neighbouring coil of the intestine, the omentum, or the abdominal wall. The same course of events may occur in fæcal fistulæ following operations.

When these fistulæ do not heal, the treatment is very difficult. No plastic operation upon the external orifice will do any good, because it only dams up the fæcal material in the abscess cavity ; the best procedure is to open the abdomen in the neighbourhood of the fistula after temporarily closing the latter by stitches, pack off the peritoneal cavity, and explore the condition of the bowel. If the opening into it is small and situated in the large intestine, it may be possible to close it by a double row of sutures, return the bowel into the abdomen, and enlarge and drain the old sinus. If the opening is too large, or if it is situated in the small intestine, the piece of bowel should be excised and a lateral anastomosis made between the parts above and below.

When the opening is immediately adherent to the skin, as is the case when a fæcal fistula has been artificially produced, the obstacle to closure in most cases is the spread of epithelium from the intestine to the skin, so that a mucous-lined tube is formed ; complete closure cannot occur under these circumstances, although considerable contraction of the orifice may take place as time goes on. Some kind of plastic operation must therefore be done when the contraction has reached its limit. In some cases paring of the edges, followed by suture, will suffice ; when the defect is larger, a true plastic operation may be done by turning a thick flap of skin and fascia over the opening after paring its edges. It may be necessary to repeat these plastic operations as small openings again form ; if these attempts fail, the affected portion of the bowel must be excised and a lateral anastomosis performed.

ARTIFICIAL ANUS.

Here there is an obstruction to the onward passage of the intestinal contents, and they are discharged through the opening. The condition is usually brought about intentionally by operation, a spur being formed by the projection forwards of the posterior wall of the intestine which acts as a valve and prevents the escape of fæces into the bowel below. This

is done in colostomy, in which one of the main points is the formation of an efficient spur. It may also occur in strangulated hernia in which the affected loop has sloughed and a spur has formed preventing the onward passage of the contents. Apart from cases of colostomy for malignant disease of the large bowel in which the opening is meant to be permanent, cases occur in which the opening is only temporary and may be closed subsequently. For example, an artificial anus may be established for intestinal obstruction, and when this condition has been relieved the abdomen may be opened again and the tumour causing the obstruction removed. Again after resection of gangrenous intestine, when an anastomosis has not been made at the time, subsequent closure of the orifice becomes important. Or again when colostomy has been done for ulcerative colitis or some other inflammatory condition, the opening may be closed when the disease has passed off.

TREATMENT.—In all these cases the essential point is to get rid of the spur, and various methods have been employed for the purpose. In most cases the proper procedure is to open the abdomen, excise several inches of the bowel including the artificial anus, and then to unite the remaining portions. Special care is necessary to avoid introducing septic material into the abdomen. The disinfection of the skin, which is impregnated with fæcal material, should be begun and frequently repeated for at least a couple of days before the operation. At the commencement of the operation the artificial anus should be encircled by an elliptical incision and the skin dissected up around the opening, and stitched closely together so as to prevent the escape of the intestinal contents during the operation. An incision is now carried through the abdominal wall on both sides of the attachment of the bowel, and the peritoneum is opened at a spot where the latter is not adherent to the bowel beneath. The finger introduced into the peritoneal cavity will define the line of adhesion of the peritoneum to the bowel, and the part of the abdominal wall in which the opening is situated should be divided all round with blunt-pointed scissors just outside the seat of the adhesions. The bowel is thus freed from the abdominal wall and has the skin around the artificial anus still adherent to it and stitched over the orifice. The loop is drawn as far as possible out of the wound, the general peritoneal cavity is shut off by packing and a resection is performed in the usual manner.

There are other methods of getting rid of the spur, of which we may mention the use of Dupuytren's clamp, one blade of which is introduced into each portion of the intestine and then the two are gradually approximated. This sets up peritonitis between the adjacent limbs of the bowel and the part included in the clamp sloughs, and a free lateral opening is thus established between the two limbs of the bowel. The forceps shown in Fig. 157 may be used for this purpose. When the communication has been fully established, a plastic operation will usually close the external opening.

CHAPTER XXXII.

ENTEROPTOSIS OR GLÉNARD'S DISEASE: CHRONIC CONSTIPATION.

ENTEROPTOSIS.

ABNORMAL looseness of various abdominal organs is not uncommon, and this condition may give rise to very distressing symptoms. Any of the abdominal organs may be affected either singly or together, the most common being the kidneys, liver, spleen, uterus, stomach, and intestines. We shall here consider the descent of the intestinal viscera—stomach and intestines—though this condition is frequently associated with others, especially nephroptosis and hepatoptosis. In bad cases the intestines are collected at the lower part of the abdomen, the transverse colon may cross the upper part of the pelvis, there may be no proper attachment of the hepatic and splenic flexures, and the stomach, which is often dilated, may also descend well below the umbilicus.

The result of this displacement is to give rise to *symptoms* which often render the patient a chronic invalid; they consist of dragging pains due to the unsupported weight of the intestines, various troubles in connection with the altered position of the organs and kinking of various parts of the intestinal tract, and a general neurasthenic condition. The pyloric orifice of the stomach is displaced and may be kinked, the stomach becomes dilated, and dyspeptic symptoms and signs of pyloric obstruction are very common. Chronic constipation is often marked, and is accompanied by mucous colitis and meteorism. There is generally also wasting and loss of strength. These patients may be very emaciated, and frequently take food badly. The statements of the patient as to pain and discomfort are often distractingly vague and variable, and are apt to lead one to look on the case as one of neurasthenia.

The shape of the abdomen is often very characteristic. Gallant (*International Clinics*, vol. i., 15th series, 1905) has made curves of the

naked abdomen in these cases which show that, while in the healthy abdomen in the erect posture the point of maximum protrusion is above the umbilicus, in Glénard's disease this point is well below the umbilicus and there is a hollow above (see Fig. 171). In examining the abdomen in these cases he first measures the waist with the corsets and clothing on, and then, having removed them, applies a band around the waist in the same position as the narrowest part of the corsets, and tightens it up until the measurement is the same as before undressing. This shows the exact change in shape produced by the clothing; and he finds a remarkable increase in the protrusion of the lower part of the abdomen in these cases when the clothing has been put on. In the recumbent position the point of greatest prominence in enteroptosis is above the umbilicus, while normally it is below. Beyond the general pendulous condition of the abdomen and its shape, and the presence of dilatation of the stomach there is nothing much to be made out on examination unless the liver, kidneys, or spleen are also movable.

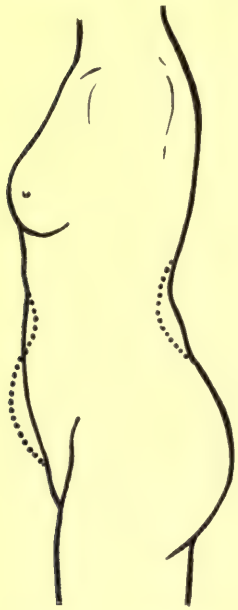


FIG. 171.—ENTEROPTOSIS. The continuous line shows the normal outline, the dotted one that of a patient with enteroptosis.

It is uncertain how far this condition is congenital and due to such conditions as abnormal length of the mesentery or imperfect fixation of the hepatic and splenic flexures of the colon. The two most important *exciting causes* are distension of the abdomen, with consequent flaccidity of the walls, as after repeated pregnancies, and the management of the feminine clothing, especially the erroneous use of corsets. Hence this condition is comparatively rare in men as compared with women. A pendulous state of the abdomen and separation of the recti are very important factors; under these circumstances the intestines lose their natural support. This will also tell on the liver and kidneys, and thus a general descent of the abdominal organs may result. As regards the management of the clothes, the chief factor is the weight of the clothing which is hung around the waist. The use of corsets is often blamed as the essential cause, but while tight lacing is no doubt a frequent source of trouble and may lead to flattening out of the right lobe of the liver, and may push down the abdominal organs, corsets when properly used are not without value. The great advantage of corsets is that they help to protect the abdomen from constriction by the tapes and bands used in suspending the nether garments. When no corsets are worn, these bands and tapes are a fruitful source of trouble, and probably do as much harm as tight corsets. Ladies who do not use corsets should therefore

suspend their garments from the shoulders. Corsets undoubtedly aggravate the condition of enteroptosis if they are put on in the wrong position. They are usually put on while the patient is in the erect posture, and they are apt to be drawn too tight at the upper part. If a patient suffers from hernia the rule is that he shall lie down and replace the hernia in the first place before applying the truss, and put on the truss while in the recumbent position, and the same rule should hold good in regard to corsets in the case of those who have a tendency to enteroptosis. If the corsets are put on and tightened up in these cases while the patient is in the erect posture the abdominal organs which are already hanging too low are held in that position, and when the additional weight of the petticoats is added they are still more pulled down and the condition is consequently aggravated.

Dr. A. Keith, in his excellent lectures on enteroptosis (*Lancet*, March 7 and 14, 1903), states that the condition is due to the upsetting of the balance between the inspiratory and expiratory muscles. He looks on active contraction of the crura of the diaphragm as the most important factor. According to him there are two causes of displacement of the liver and stomach—namely, relaxation or paresis of the abdominal muscles which maintain the shelf on which these organs are supported, and constriction of the abdominal cavity by clothing or contortion by disease preventing the forward rotation of these organs during respiration. Corsets, by pushing in the ribs, make the action of the costal fibres of the diaphragm more vertical, and thus more active in pushing down the viscera.

TREATMENT.—The treatment of enteroptosis is both local and general, the former aiming at giving support to the abdominal contents, and the latter at improving the general health and the neurasthenic condition.

General.—In bad cases it is advisable to begin with an ordinary rest-cure in bed, lasting six or eight weeks, gradually increasing the amount of food and the massage. In applying massage special attention should be paid to the abdomen with the view of strengthening the abdominal muscles ; none of the actions must cause any downward pull on the abdominal contents. The ordinary indiscriminate kneading of the abdomen may do more harm than good.

Local.—This is directed to supporting the abdominal contents and thus removing the drag of the stomach and intestines, and may be non-operative or operative. The *non-operative* treatment consists in the use of various means to hold up the lower part of the abdomen and push up the abdominal contents ; this may be done by strapping, belts, corsets, or a combination of these. Strapping has been a good deal used, but it is very inconvenient, and can only be a temporary expedient ; it is best to use either a corset or a belt, or a combination of both.

The first essential is not to apply the support until the prolapsed organs

have been returned to the upper part of the abdomen. The patient should lie on her back with her hips raised, so as to allow the prolapsed viscera to resume their natural position by gravity, and this is facilitated by pushing them up and stroking the abdomen in the upward direction. The belt, or the combined corset-belt (see Fig. 173), is then slipped on loosely. The belt has firm and accurately fitting sides and front, and surrounds the pelvis, extending above the crest of the ilium and as low as possible. When the abdomen is very lax, especially if it is hollow and

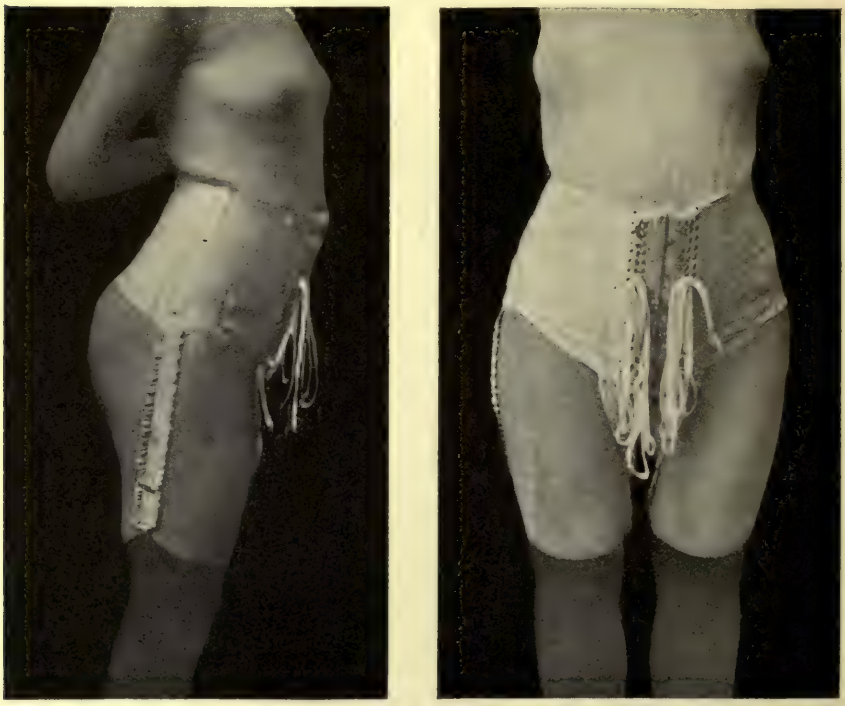


Fig. 172.—Belt for Enteroptosis.

retracted, the patient may be made more comfortable by fitting the belt or corset with a crescentic pad above the pubes and over each iliac fossa. In arranging for a corset the patient, while lying on her back with the viscera replaced as far as possible, is measured for a corset, which must fit closely over the hips and suprapubic region, but must afford sufficient room above the umbilicus for the replaced colon and stomach. In lacing the corset, two separate strings are used, one beginning at the bottom and lacing up to the first eyelet below the umbilicus; this must be drawn as tight as can be borne. The second lace begins where the lower leaves off, and is laced up to the top, but must never be drawn tight. Sometimes it is advisable to divide the lace into three parts. Any tendency of

the corset to ride up indicates that it has not been laced tightly enough below the waist, or that it has been laced too tightly above, or that it is too large. The lower end of the corset can be kept closely applied above the pubes by attaching the suspenders to each end in front and fastening them to the stockings at the inner and back part of the thigh.

A very efficient corset is made as follows: A number of strips of webbing long enough to go round the patient's waist are laid side by side so as to overlap by about one-third of their width. These are now sewn to another piece of fabric so as to make a sort of many-tailed bandage. The patient is laid on her back with her pelvis supported by a firm wedge-shaped pillow, and the strips of webbing placed in position beneath her. Each strip is then brought round and fastened in front. The position of each strip is then marked and the whole ultimately finished off by the corsetière. A pad may also be placed over the pelvic region beneath the corsets, and the close application of the lower part of the corsets may be still further insured by attaching broad strong bands to the corset on each side below the level of the anterior superior spine and buckling them in front (see Fig. 173).

Fig. 173.—Combined Abdominal Belt and Corset. The belt portion is constructed of straps of strong webbing sewn together and is fastened or adjusted by separate laces. It is kept in position by the thigh-piece and suspenders. (*Mmes. Bruce and Evelyn, 93 Wigmore Street.*)

Sometimes it is of advantage to incorporate a metal plate with the corset or belt. This plate, which consists of thin steel or aluminium, is made to a plaster-cast of the hypogastric region. Such a cast is readily made by greasing the abdomen and spreading over it a sheet of lint saturated with plaster of Paris while the patient is in the recumbent position. This is allowed to set, and then removed. The positive cast is made by filling up the mould

with tow soaked in plaster after first greasing it and filling up any holes with soap.

The *operative* treatment of these cases has received very little attention, and, considering the nature and extensive character of the deformity, no cure can be expected from operation. At the same time, a considerable amount of benefit has resulted in a few cases on which we have operated, and, with the aid of suitable corsets, the patient's condition has been much improved. In cases of dilated stomach without any obstruction to the exit of the contents—cases which in all probability belong to the group of enteroptosis—gastroplication or taking tucks in the stomach has been performed; but the operation has fallen into disuse. Gastro-jejunostomy has also been done with little or no benefit. It seems to us that attempts to remedy the trouble by operation must be directed towards raising and keeping up the viscera. The stomach can be raised to some extent and (what is probably of more importance) steadied by taking tucks in the gastro-hepatic omentum. This can be done by passing a series of catgut stitches in a vertical direction through the upper and lower part of this omentum and tying them. In these cases also the hepatic and splenic flexures of the colon are loose, and therefore in addition to the above procedure we also stitch up the hepatic flexure to the under surface of the liver, as far as possible in its normal position, and the splenic flexure to the under surface of the diaphragm. In many of these cases the liver is also loose, and we have fastened it to the diaphragm in the manner referred to in speaking of hepatoptosis (see Vol. V.). When the recti are separated and the abdomen is very pendulous advantage will also be gained by suturing the walls and bringing the recti together. These various procedures may be carried out through a long vertical incision to the right of the middle line, but a transverse limb below the ribs on the right side will be necessary when the liver has to be sutured, and this facilitates the fixation of the hepatic flexure of the colon. The looseness of the kidneys, which is practically always present, may be dealt with later, if necessary (see Vol. V.).

CHRONIC CONSTIPATION AND INTESTINAL STASIS.

This is a condition which has been usually regarded as lying within the province of the physician, but of late years attempts have been made to relieve it by surgical means. The chief work in this department has been done by Mr. Arbuthnot Lane who has written much on the evil effects of intestinal stasis. These he attributes to the absorption of the products of decomposition, and holds that this occurs to a greater extent from the small intestine than from the large. According to him not only does it exert a deleterious effect upon the patient, producing such conditions as anæmia, mental depression, languor, and general ill-health, but also strongly predisposes or even leads to the occurrence of various

other diseases, such as tuberculous diseases of glands and joints, rheumatoid arthritis, mastitis, cancer, and many others. Indeed, Mr. Lane goes so far as to recommend operations for intestinal stasis as the first procedure in the treatment of these diseases. As yet few surgeons have felt able to follow Mr. Lane's lead in these matters, and we should have the greatest hesitation in recommending intestinal anastomosis for such cases as tuberculous gland- or joint-disease or chronic mastitis. In our opinion it is very problematical whether any real benefit would result from these operations in such cases, and the operation itself is a very severe one and apt to leave behind it very unpleasant consequences. But as a means of dealing with intestinal stasis itself, due to atony or atrophy of the colon or to extensive adhesions matting the bowels and preventing their proper movements, or to kinks such as Mr. Lane describes in the lower end of the ileum, his suggestions must be carefully considered.

Two operative procedures are proposed—namely, ileo-sigmoidostomy and excision of the colon. In the former operation the small intestine is cut across at its lower end and implanted into the sigmoid flexure while, the distal end is closed by sutures. This operation is not accompanied by much danger, but it has the great disadvantage of leaving the whole of the large intestine above the anastomosis as a blind tube in which fæcal material and intestinal secretions may collect and still lead to absorption.

In order to overcome this, it has been suggested that appendicostomy should also be performed with the view of washing out the colon, but this entails constant lavage of the intestine and much trouble to the patient.

The most logical method of getting rid of this difficulty is excision of the entire colon, but this is a measure of such severity that it can only be justifiable in a small percentage of cases. The advisability of performing this operation must, however, be considered in some cases, but it must be admitted that the type of patient in which it may be necessary is an unpromising one. It is a question whether partial operations, such as excision of the lower end of the ileum and the ascending colon in cases in which the trouble is situated in the lower end of the ileum or the first part of the colon, as is apparently not uncommon, followed by anastomosis of the ileum with the transverse colon, would not be more advantageous than either of the above operations.

ENTERO-SPASM.

Spasmodic contraction of the intestinal wall occurs in connection with various conditions and is an important factor in many forms of intestinal obstruction. It is an essential element in obstruction by gall-stones, for example, for it is seldom that the gall-stone itself blocks the canal sufficiently to produce obstruction ; this is brought about by the

reflex contraction of the muscular coat of the intestine. In Richter's hernia, too, in which only a small part of the wall of the bowel is nipped, if complete obstruction occurs it is probably brought about by entero-spasm. This is also probably the explanation of the obstructive symptoms which accompany torsion of tumours, of undescended testicles, or of the omentum, and which creates a difficulty in the diagnosis. Spasm may also be present in connection with ulcers in the stomach and bowel just as in fissure of the anus; this is especially evident in the gastro-spasm and pyloro-spasm, which not infrequently accompany ulcer of the stomach. It may also be set up by the irritating nature of the gastric or intestinal contents. Drugs, such as lead, may set up spasm, and spasm is possibly a factor in the abdominal crises of loco-motor ataxia.

Apart from the occurrence of entero-spasm as a secondary factor in various forms of obstruction, it may also be the chief agent in some cases. In some hysterical patients, symptoms of intestinal obstruction may arise, accompanied by marked dilatation of considerable portions of the intestine. When the abdomen is opened, a spasmodically contracted portion of intestine may be found below the dilated part. Apart from hysteria, however, a condition of painful spasmodic contraction of the intestine or the stomach may occur, to which the name of entero-spasm (or gastro-spasm) is applied; abdominal angina is probably only another name for the same condition. Entero-spasm may occur anywhere in the intestinal canal; in the upper part it may be mistaken for biliary colic, and it may lead to acute dilatation of the stomach; in the neighbourhood of the cæcum it may lead to a diagnosis of appendicitis, in the lower colon to the formation of a thickening and a diagnosis of carcinoma.

The subjects of this condition are most commonly women—frequently of a distinctly neurotic type—and in some cases it may be associated with some emotional or mental disturbance. The pain is frequently severe and usually occurs at intervals with periods of complete cessation or of dull pain. It is often accompanied by violent retching and vomiting. The abdomen is not rigid, but there may be localised tenderness. There is not the complete constipation characteristic of mechanical obstruction; indeed, in some cases the bowels act fairly easily with enemata.

TREATMENT.—The really important point is the diagnosis, for, on the one hand, it is not only useless, but very inadvisable to open the abdomen for this condition; while on the other, if the case is really one of obstruction, delay in operating is most serious. When this condition is present, the two things which are of chief value are trinitrin (gr. $\frac{1}{250}$ to $\frac{1}{100}$)—injected hypodermically when a severe spasm is present and repeated every three or four hours if necessary—and atropine. Of these we prefer the former on account of its rapidity of action, but the effect of atropine is more prolonged. Valerianate of zinc

in pill (gr. 3 to 5) is also recommended. Attention must also be paid to the diet, soft and easily digestible food being given, and the bowels should be kept open, but no irritant purgatives should be administered; aloes and rhubarb are probably the best.

It has been suggested that if the abdomen is opened, the appendix should be removed, especially when the case has been mistaken for appendicitis. It is, however, always advisable, to avoid opening the abdomen at all, because the intestine is very apt to become enormously distended afterwards, and in more than one case the stitches have given way and the bowels have protruded through the wound.

DIVISION IV.

THE SURGICAL AFFECTIONS OF THE RECTUM AND ANUS.

CHAPTER XXXIII.

ANATOMY OF THE RECTUM AND ANUS: METHODS OF EXAMINATION.

ANATOMY.

From an operative point of view the old anatomical description of the rectum is the most useful. In that description the rectum was said to be a continuation of the sigmoid flexure, to begin opposite the left sacro-iliac synchondrosis, to terminate at the anus, and to be about 8 inches in length. In the following pages our remarks refer to the lower eight inches of the bowel.

At the present time anatomists speak of the pelvic colon (formerly in great part the sigmoid flexure and in part the upper portion of the rectum), the rectum, and the anal canal.

The *pelvic colon* forms a loop about 16 inches in length, and normally lies within the pelvis. It is completely surrounded by peritoneum which forms a mesentery.

The *rectum proper* begins at the level of the third sacral vertebra and ends at the anal canal about an inch in front of the tip of the coccyx; it is about 5 inches in length. Above, the peritoneum covers it in front and at the sides, and lower down in front only; it is then reflected on to the vagina in the female and the bladder in the male. In the female this point of reflection is about $2\frac{1}{4}$ inches above the anal canal; in the male it is higher—about 3 inches. The rectum is surrounded by a dense tube of fascia which contains also fat, lymphatic glands, and blood-vessels;

the glands lie behind and at the sides of the rectum. Behind, are the superior hæmorrhoidal vessels, the left pyriformis muscle, and the left sacral plexus above, the sacrum, coccyx, and levatores ani below. In front in the male are the bladder, the trigone, the vesiculæ seminales, and the posterior surface of the prostate.

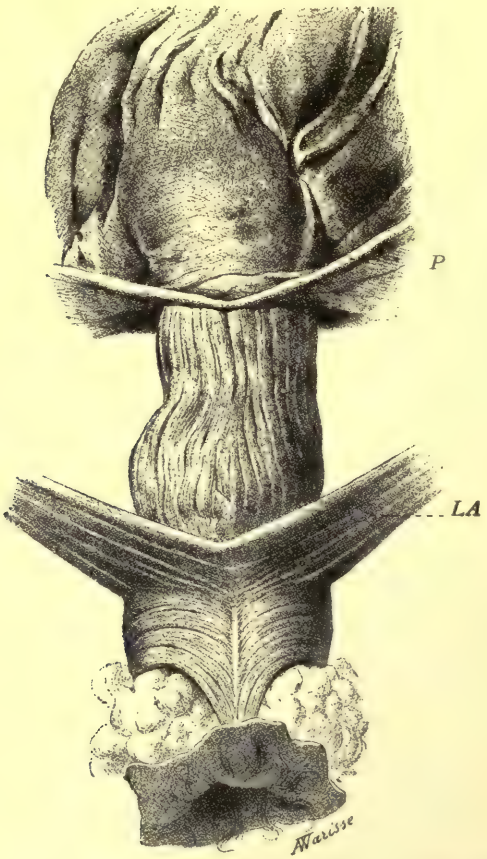


FIG. 174.—A DISSECTION OF THE RECTUM SHOWING THE ARRANGEMENT OF THE PERITONEUM AND THE LEVATOR ANI. This shows the rectum really divided into three portions, the upper one partially invested by peritoneum, the middle one quite devoid of any peritoneal investment, and the lower one extending from the insertion of the levatores ani to the anal orifice. *P*, peritoneum; *LA*, insertion of the levatores ani. (*Hartmann and Quénu.*)

The anal canal is about 1½ inches long and curves backwards, being limited above by the attachment of the levatores ani, and below by the external sphincter. It is not in relation to the peritoneum, and is embraced by the internal sphincter (see Fig. 174). In the male the urethra is in front of it, in the female, the posterior wall of the vagina.

The rectal mucous membrane is thrown into a series of folds, arranged

transversely to the long axis of the bowel, the most important of which are known as Houston's folds. The lowest projects from the left-hand wall of the rectum opposite the prostate ; the middle one projects from the right-hand wall about 3 inches above the anus, whilst the upper one projects from the left-hand wall near the commencement of the rectum. When the bowel is empty these folds stand out about half an inch from the rectal wall and overlap one another, and they thus serve to keep the pressure of the rectal contents off the sphincter.

There are also longitudinal folds (the columns of Morgagni) prolonged upwards from the radiating folds about the anus, which are united at their lower ends by small valvular folds of mucous membrane, and serve to prevent the escape of the liquid contents of the bowel. It is amongst these folds that a fissure of the anus usually occurs.

The arterial supply of the rectum is derived partly from the mesenteric and partly from the internal iliac vessels. The entire upper part is supplied by the superior hæmorrhoidal branch of the inferior mesenteric artery, the mucous membrane of the middle part is supplied by the same vessel, while the rest of the wall is supplied by the middle hæmorrhoidal branch of the internal iliac ; the lower part is supplied by the inferior hæmorrhoidal branch of the internal pudic. These vessels perforate the muscular coats and run down vertically in the sub-mucous tissue, anastomosing freely with one another by cross branches.

The veins about the anus form the hæmorrhoidal plexus, and run vertically upwards, passing through slits in the muscular walls ; they are without valves, and therefore the circulation in them is readily interfered with by distension of the bowel. The lower veins join the systemic circulation, the upper ones empty into the inferior mesenteric vein, and thence into the portal circulation. There is free communication between the two sets of veins, so that an obstruction to the hepatic circulation may give rise to distension of the plexus, and consequently to hæmorrhoids. The arrangement of the vessels above described is best seen in the lower four inches of the bowel.

The lymphatic vessels of the rectum proper pass into the internal iliac group in the lateral wall of the pelvis. From the pelvic colon they run to the glands between the layers of the meso-sigmoid.

The nerve supply is from the pelvic plexus of the sympathetic, and this is reinforced by branches of the second, third, and fourth sacral nerves, the supply from the last-named being most abundant.

METHODS OF EXAMINATION.

The physical examination of the rectum may be carried out either by palpation or by inspection.

Inspection of the external parts is effected by separating the folds of the anus and making the patient strain while he bends over the back

of a chair, with the knees extended ; hæmorrhoids, a polypus, a prolapse, or a fissure of the anus are thus often easily detected.

By means of the finger nearly the whole of the mucous membrane of the rectum proper may be investigated, according to the position of the patient. Unless the rectal affection be a very painful one, an anæsthetic should not be used—at any rate, at first—and the patient should lie on the left side rather than over on the face, and should have the knees well drawn up. The rectum should be emptied by a purge administered overnight, and it is also well to wash it out with an enema just before the examination. The index finger—which may be protected by a lubricated rubber glove or fingerstall—is insinuated through the anal orifice, and as much of the rectum is palpated as is within reach. If the patient is made to stand up or to strain, or if the surgeon compresses the abdomen forcibly, an additional inch or so of the rectum can be brought within reach of the finger. Any examination with a bougie is untrustworthy and not worth carrying out.

Fig. 175.—Kelly's Proctoscope.

Examination of the rectum proper must be effected by direct vision, and is best carried out by means of special specula, of which those designed by Kelly and termed *proctoscopes* are the most useful. These are cylinders of varying length up to 5½ inches, with a rounded obturator (see Fig. 175). They are introduced within the anus ; the obturator is withdrawn, air passes in and expands the bowel, and the lower part of the mucous membrane of the rectum may be inspected as the speculum is slowly withdrawn. The speculum should be pushed slightly upwards every now and then, so as to stretch the mucous membrane and to open out its folds. Reflected light from a forehead mirror is necessary for this examination. An improved form of proctoscope is also in use, furnished with an electric lamp near its distal end, which gives perfect illumination.

For examination of the pelvic colon and the upper part of the rectum. the instrument known as the *sigmoidoscope* is now in common use, and enables the observer to inspect the mucous membrane of the lowest thirteen inches or more of the bowel. The instrument is shown and described in Fig. 176. It can be used without anæsthesia in many cases—especially in women—but general anæsthesia may be required for nervous patients or those who are the subjects of an enlarged prostate or a painful affection of the rectum. The patient should lie upon the left side upon a high couch or table, with the knees drawn well up and the buttocks projecting

over the edge. The tube, with the obturator in position and well warmed and lubricated, is inserted gently through the anus, the point being first directed backwards into the hollow of the sacrum. As soon as it has passed well within the anus the obturator is withdrawn, the electric lamp substituted, and the light switched on. Then the hand-bellows are worked, and the eye applied to the eyepiece. As the inflation proceeds, the rectum is distended, its walls and folds separate, and it can be seen in what direction the tube should be passed. It is gently pushed on,

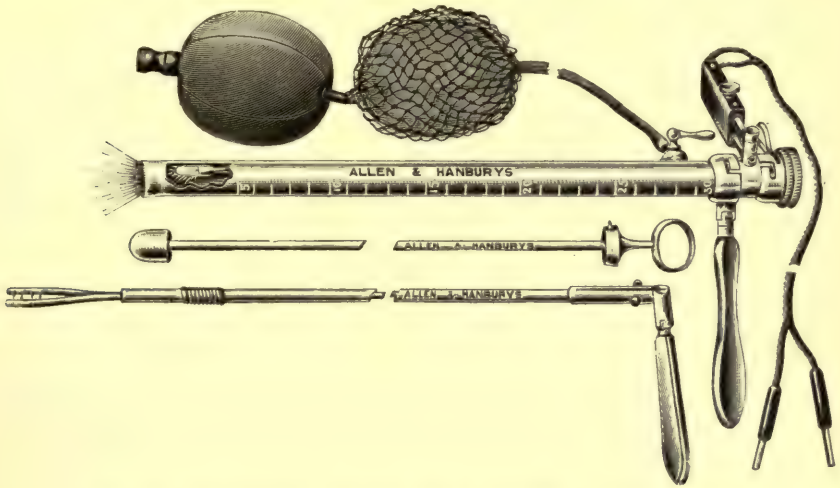


Fig. 176.—Sigmoidoscope. Above is seen the tube carrying an electric light in its interior and furnished with a bellows for inflation. Immediately beneath this is the obturator, and below this again a pair of forceps for manipulations inside the tube.

while the inflation is kept up, until it has passed to its full length or until its passage is obstructed by some obstacle, the nature of which may be made out by direct vision. The eyepiece is removable for the purpose of introducing forceps in order to remove portions of tissue, or mop away fæcal matter or mucus. If the bowels have been cleared out thoroughly beforehand—as should always be the case—very little fæcal material gets into the tube. In the hands of anyone accustomed to use it, this instrument is of great value, and has led to the early recognition of many lesions—such as cancer of the bowel—situated in the pelvic colon too high up to be felt from below and too hidden under the prominence of the sacrum to be felt by abdominal palpation.

There are certain points which must be attended to in order to ensure success. The bowels must be well cleared out and the greatest gentleness must be used throughout, otherwise the instrument may be forced through the bowel wall and enter the peritoneal cavity. Under no circumstances should any attempt be made to pass the tube onwards

unless and until the inflation has opened up a way for it; this is ascertained by direct vision, and the necessary deflection of the instrument can be judged to a nicety. When the examination is at an end, the eyepiece is removed and the air allowed to escape as the tube is slowly withdrawn. In skilled hands no harm results from the use of this instrument, and a little practice soon renders the observer able to manipulate it easily, provided that he never uses force. It is made in several sizes, including small ones suitable for children or for passing through strictures in order to ascertain their length and the condition of the bowel beyond them.

In addition to this physical examination, careful inquiries must be made as to the character of the stools, the existence and nature of discharges from the rectum, the occurrence of any protrusion during defæcation, and various other points—all of which are dealt with in connection with the individual affections.

CHAPTER XXXIV.

IMPERFORATE ANUS AND RECTUM.

THESE important congenital deformities go by the generic term of 'imperforate anus,' but they are better divided into the two separate classes—imperforate anus and imperforate rectum.

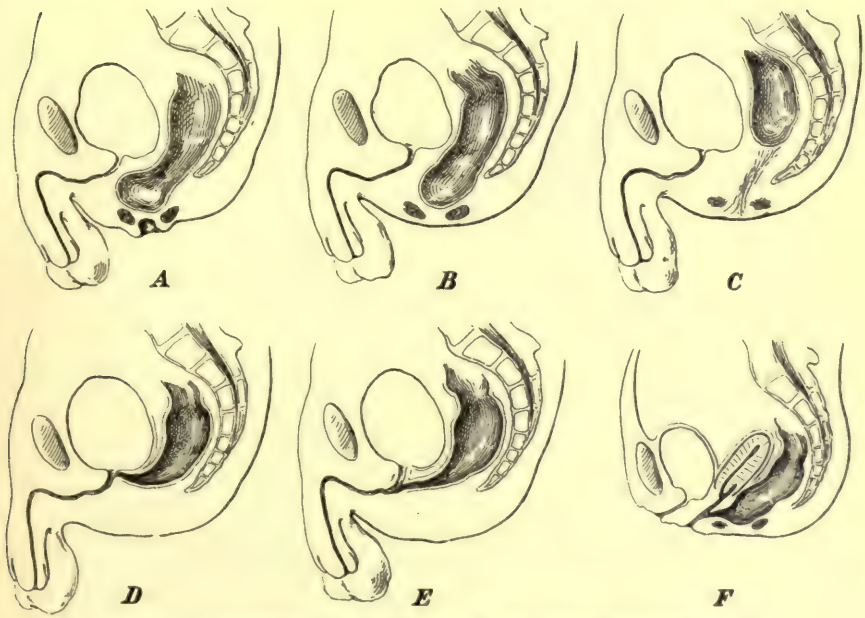


FIG. 177.—DIAGRAMMATIC REPRESENTATION OF THE DIFFERENT VARIETIES OF IMPERFORATE ANUS. *A* and *B* represent two common varieties; in the former the anal depression is developed, in the latter it is absent. In both the sphincter is developed and the rectum extends down to the perineum. In *C* the rectum ends high up in the pelvis. In *D*, *E*, and *F* there is a fistulous communication with the bladder, urethra, and vagina respectively.

The rectum is developed from the hinder end of the primitive gut, and is therefore derived from the hypoblast and mesoblast. The anus, on the other hand, is developed from the cloacal depression in the epiblast, which

gradually approaches the primitive gut until finally the septum between the two disappears and leaves a single tube. Simultaneously, the anterior part of the cloacal slit is shut off from the alimentary canal and forms the urethra and the perineum.

Various malformations may be met with (see Fig. 177). Thus the rectum, and in some cases even the large intestine also, may be absent; here, however, the anal depression is often well marked, but it also may be wanting. On the other hand, the rectum may be fully developed and the anal depression may be absent; or both may be present, but divided from each other by a definite septum. Hence the presence or absence of the anal depression gives no clue to the condition of the rectum.

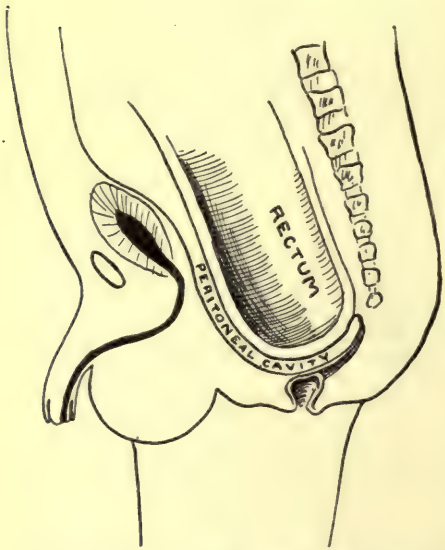


FIG. 178.—IMPERFORATE ANUS. Diagram to illustrate how the peritoneal reflection intervenes between the dilated rectum and the imperforate anal dimple.

The deformities may be grouped into the following classes:—

1. The rectum and the anal dimple are both developed, but are separated by a septum. Of this variety there are two distinct types. In the first there is merely a thin septum separating the interior of the two parts; in the other and more common condition there is a fibrous cordlike structure of variable length reaching from the one to the other. The peritoneum comes into close relation with this cord in front. As the upper end of the bowel becomes distended it is pressed down upon the apex of the anal depression and gives the impression of the existence of a mere septum; but it is not so, for there is a reflection of peritoneum between the two, and a knife thrust through the apparent septum would open the peritoneal cavity (see Fig. 178).

2. The entire rectum, or a part of it, or even of the large intestine, is absent, but the anal depression is present.

3. There is no trace of an anus, but the rectum is present. Occasionally, both anus and rectum are absent.

4. The anus may be developed, but imperforate, and the rectum may have formed a fistulous communication either with the skin—in which case the fistula opens in the neighbourhood of the perineum—with the scrotum, the penis, or, more frequently, the bladder or urethra

in the male, or the vagina in the female. In addition to the true imperforate cases there may be atresia or a mere pinhole anus.

Hence, we have to consider the following groups: Complete absence of the rectum, or a considerable portion of it; a septum or a fibrous cord between the anus and the rectum; the existence of a rectum with or without an anus; and fistulous communications between the rectum and other parts.

When either the anus or the rectum is imperforate there is complete obstruction, and the patient must die unless speedy relief is afforded. When, however, there is a mere pinhole opening or a fistulous communication exists between the rectum and the skin, the bladder, the urethra, or the vagina, a certain amount of meconium can escape. The communication, however, is usually narrow and may be tortuous, and the relief is incomplete, so that death will usually occur eventually, unless surgical measures are carried out.

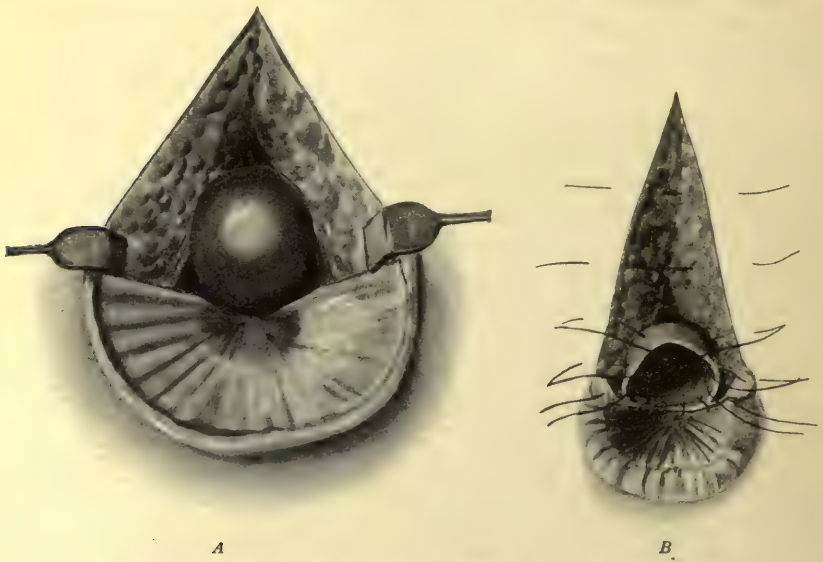
FIG. 179.—POSITION OF THE CHILD IN THE OPERATION FOR IMPERFORATE ANUS. The incision is shown; a nasal speculum is used to open up the anal dimple.

TREATMENT.—This is difficult, because the child is only a few hours old and cannot stand a prolonged or extensive operation, the parts are so small that anything like efficient manipulation is difficult, while obstruction is always present.

When there is a septum between the rectum and anus.—These are the simplest cases to treat, as the rectum and anus are well developed, but they are not nearly so common as is supposed (*vide infra*). When there is merely a diaphragm between the two, the finger, passed into the anal dimple, will feel the bulging of the lower end of the rectum when the child cries or when pressure is made upon the abdomen, and it is easy to make the two communicate by pushing a tenotome or small bistoury through the septum and dilating the puncture with sinus forceps. An opening just large enough to allow the escape of the meconium should be made at first, and it is well to tie in a rubber drainage tube. This opening may be enlarged two or three days later by making a cross-cut through the septum and stretching it fully, and should be kept dilated by a well-oiled finger passing gently through it two or three times daily, this dilatation being kept up for at least twelve months.

The surgeon must, however, be certain that there is only a thin

diaphragm present; much more frequently the lower end of the rectum covered by peritoneum projects on to the upper part of the anal canal, and if the above operation is performed, extravasation of the intestinal contents takes place into the peritoneal cavity. Some idea may be gained as to whether it is a mere septum or not by introducing a small speculum—a nasal one serves the purpose well—and inspecting the top of the anal depression. When there is a mere diaphragm the roof is smooth, bluish in colour near the top, and somewhat convex downwards; when, on the other hand, a fibrous cord unites the two parts the roof is



A *B*

FIG. 180.—THE OPERATION FOR IMPERFORATE ANUS. *A* shows the distended lower end of the gut approached from behind after the anal depression has been slit backwards to the coccyx. *B* shows how it is sutured to the wound after being opened. It is attached partly to the cut margins of the anal dimple and partly to the skin.

irregular and puckered, less bluish and not convex downwards, unless the distension is great. In any case of doubt the following procedure should be adopted (see Figs. 179–181).

The child is either held by the nurse or placed face downwards over a pillow so that the pelvis is raised and the hip-joints are well flexed (see Fig. 179). The surgeon sits facing the buttocks, and makes a median incision from the tip of the coccyx into the anal orifice, dividing the whole posterior wall of the anal canal, including the sphincter. He then separates the tissues in the middle line in the hollow of the sacrum and approaches the distended end of the rectum from the posterior aspect (see Fig. 180, A). A vertical incision is made into the gut, the edges seized in forceps and sutured accurately to the margins of the skin wound and the mucous membrane of the anal canal (see Fig. 180, B), and

a drainage tube inserted into the bowel to ensure its proper evacuation. The subsequent patency of the anus can be maintained by the means described above; but if necessary, a plastic operation may be performed at a later date, the scar tissue being excised, the sphincter repaired, and the mucous membrane freed and brought down and sutured to the anal margin all round. All these operations are very difficult owing to the excessive smallness of the parts that have to be dealt with. By working from the hollow of the sacrum towards the distended bowel in the manner described, there is no fear of going through the peritoneal reflection when the gut is opened—a frequent cause of the fatal results that were so prevalent when it was the custom merely to thrust a knife through from the anal depression (see Fig. 178).

Fig. 181.—Diagrammatic Section to show how the communication is made between the Rectum and the Anal Dimple. The sketch shows how the peritoneal reflection is avoided by working in the hollow of the sacrum.

When there is no indication as to the position of the lower end of the rectum.—Whether the anal dimple is or is not present, the first step is to make a careful search for the blind end of the gut from a median incision from the coccyx to the mid-point of the perineum) and this is gradually deepened until the bowel, if developed, is met with, the surgeon working from the hollow of the sacrum (*vide supra*) so as to avoid the peritoneal reflection.

In some cases the distended end of the gut presses down the perineum and bulges forcibly beneath the skin every time the child cries, and in these the end of the bowel will almost immediately present, showing its characteristic dark bluish-black appearance. An incision is made into it, the edges of the orifice in the bowel seized with tenaculum forceps, pulled down and secured by a few silkworm-gut sutures to each side of the skin incision.

When there is no bulging in the perineum and there is doubt as to whether the rectum is developed at all, the treatment becomes more difficult, as there will be a considerable thickness of soft parts between the skin and the gut. The incision must be steadily deepened, and the surgeon must burrow up in the hollow of the sacrum in search of the gut. If it is found, it should be seized with catch-forceps on each side, gently separated from the surrounding structures, and brought down as far into the wound as possible before any opening is made into it. Stitches —through the muscular wall of the rectum only—are then substituted for the forceps, and their ends are passed through the skin on either side of the anal incision. The bowel is now incised and the meconium

allowed to escape. If the gut can be drawn down close to the skin it may be possible to suture the cut edge of the mucous membrane to the skin margin with a few points of silkworm-gut (see Fig. 180). A drainage tube is introduced into the bowel so as to keep the cut surfaces apart. In three or four days dilatation is commenced, and kept up by insinuating a well-oiled little finger into the bowel, and this must be continued for a long time so as to prevent contraction. If necessary a plastic operation may be done later.

When the bowel is at some distance from the perineum it will be impossible to bring it down and stitch the mucous membrane to the skin as described above. Under these circumstances dilatation alone must be relied on to keep the opening patent after the operation. A useful plan is to cause the child to wear a small india-rubber plug or teat, fastened in position by a T-bandage ; this, and stretching of the parts by the passage of a finger daily, may suffice to keep the stricture open until the child is old enough for a plastic operation to be performed with some prospect of success. It is quite impossible to do this at an early age owing to the smallness of the parts, and the child should be at least five or six years old before any attempt of the kind is made. The steps of the plastic operation consist in separating the mucous membrane above the stricture, excising the latter, and suturing the separated mucous membrane to the skin at the anal margin.

When diligent search shows that the rectum is not present in the pelvis, and especially when the peritoneal reflection has been opened and still the end of the gut cannot be found, there is no alternative but to perform colostomy, if the child's life is to be saved. This is a most serious procedure, and, quite apart from the risks pertaining to it in a new-born infant, it is a terrible calamity to inflict on the child, and many parents will quite rightly decline to permit it when the situation is explained to them as fully as it ought to be. If colostomy is decided upon, it must be done through a median incision, because it is impossible to say how much of the lower end of the gut may be absent. A median supra-pubic laparotomy is performed, the end of the bowel is found and brought out through the wound, a Paul's or Collier's tube is inserted, and the end of the bowel secured in position as for an ordinary colostomy with immediate opening of the gut (see p. 381).

Elaborate operations—such as bringing down the bowel to the anal opening after it has been found by abdominal section—are hardly possible in infants a few hours old, though one case of recovery has been reported. There is nothing for it but to make an artificial anus—at any rate, temporarily ; should it be deemed possible to bring the rectum down at a later period, that may be attempted when the child is a few months older. It is hardly necessary to remark, however, that, even at this age, the child is scarcely likely to stand what must necessarily be a most severe operation.

When there are fistulous communications.—The only cases of this kind which are at all likely to be successful are those in female infants in which the fistula opens into the vagina. The immediate treatment will depend on the condition present. *When there is a fistulous communication with the vagina*, a fine probe bent at the end is introduced along the fistulous track from the vagina, and its point is turned downwards and pressed against the anal dimple or the skin in that region if no dimple exists. The point of the probe is cut down upon by a median incision from the centre of the perineum to the coccyx. When the bowel has been found, it is opened as already described, sutured to the skin if possible, and kept dilated afterwards (see p. 529). The fistulous track into the vagina should be left until the patient has grown up; by that time the fistula may have closed so completely that nothing further is necessary; should it persist it may be closed by dissecting out the fistulous track and suturing the mucous membrane of the vagina and the rectum separately.

When the fistula communicates with the bladder or the urethra, the treatment is extremely difficult. In the former case the risks of suppurative nephritis are very great, and the child usually dies. It may be possible to open the rectum from the perineum when the communication is with the urethra, and the bowels should then be regulated so that the fæces are kept solid, and therefore less likely to find their way into the urethra. This may be successful, and the child may escape suppurative nephritis. When, however, the opening is into the bladder, the gut generally terminates high up in the pelvis, and cannot be reached from the perineum. Here an inguinal colostomy is the only alternative. The bowel should be divided across as near to the bladder as is consistent with proper invagination of the lower end, as little of the bowel as possible being left in connection with the bladder. The upper end is then fixed into the wound, after a Paul's tube has been tied in (see p. 381), whilst the lower end is invaginated and sutured. This is an operation of the greatest severity in a child of this age, and few will survive it; even should the child live, it will grow up with a permanent artificial anus, which can never be remedied. In face of such a lamentable prospect the parents will probably refuse to allow the operation.

CHAPTER XXXV.

INJURIES OF THE RECTUM: FOREIGN BODIES.

INJURIES.

INJURIES of the rectum are not very common, but are very serious when they occur. They may be met with in association with fractures of the pelvis (more particularly fractures of the sacrum) and also as the result of the penetration of foreign bodies from below.

Lacerations of the rectum, produced by fractures of the pelvis or sacrum, are of extreme gravity, as a communication is established between the intestine and the fractured bones, and this will often result in an osteomyelitis and a spreading pelvic cellulitis, which is generally fatal. The rectum may also be completely torn across, and here the result is usually the same. The patient is often so collapsed that any attempt to carry out the obvious line of treatment—namely, the repair of the injury to the rectum and the cleansing of the peritoneal cavity—is out of the question.

Penetrating wounds of the rectum.—These may be due to the penetration of a foreign body, as when the patient falls in the sitting position on to a pole or a stick. Minor degrees of wounds of the rectum are also produced by foreign bodies introduced into the bowel. These wounds may be complicated with injury of the bladder.

The seriousness of an injury of this kind depends upon whether or not there is a communication between the lumen of the bowel and the peri-rectal cellular tissue or the peritoneal cavity. When the mucous membrane alone is injured the prognosis is not very grave, the chief risk being hæmorrhage, which may be free and which is especially serious from the fact that it may go on for a long time unnoticed, because the contraction of the sphincter may prevent the escape of blood externally, and considerable distension of the rectum with blood-clot may occur.

TREATMENT.—This will vary according as the injury to the rectum is associated with fracture of the pelvis or with rupture of the bladder, or extends into the peritoneal cavity or into the peri-rectal

cellular tissue. The sigmoidoscope (see p. 522) is very useful in clearing up these points and so assists the treatment.

(a) Of lacerations associated with fracture.—When the bowel is torn across as a complication of a fracture of the pelvis or sacrum the case is very serious.

When the laceration extends into the peritoneal cavity the natural line of treatment is to perform a median sub-umbilical laparotomy, to find and try to repair the wound in the rectum, and to cleanse the peritoneal cavity. These cases are usually associated with extensive fracture of the pelvis, and in the majority the patient's condition is too desperate to allow this to be undertaken, and death from septic peritonitis occurs. Should there be any prospect of carrying out this method of treatment successfully, it should be undertaken and it may be done under spinal anæsthesia. The details are practically the same as for a similar injury to the stomach. The abdomen should be opened in the middle line immediately above the pubes, and, after the extravasated fæcal material has been removed from the pelvic or general abdominal cavity by the methods already described in connection with injuries of the stomach (see p. 244), the patient should be put in the Trendelenburg position so that the intestines fall out of the pelvis, and the wound in the rectum should be searched for and sutured in the ordinary manner, if possible. This may be excessively difficult, especially when the rent is low down and is partly intra- and partly extra-peritoneal. A large drainage tube is inserted into Douglas's pouch down to the neighbourhood of the injury, and this should be packed round with gauze and made to emerge from the incision just above the pubes.

When there is an extensive *laceration of the rectum below the reflection of the peritoneum*—an injury which is more commonly associated with a fracture of the sacrum than of the pelvic girdle—the best plan is to cut down by the side of the bowel and try to reach the seat of injury from the perineum. This is done through a crescentic incision around that side of the anus on which proctoscopic examination shows the injury to be. The incision is deepened in the ischio-rectal fossa until the rent is reached, and then the tissues are thoroughly opened up, drained with tubes, and packed with iodoformed gauze so as to prevent as far as possible the septic cellulitis, which will otherwise certainly occur ; an incision of this kind gives free exit to any sloughs or discharges that may occur. The wound should be left widely open. It is well to confine the bowels for a few days afterwards, and then subsequently to keep them open by suitable laxatives. The wound should be frequently syringed out in order to get rid of all particles of fæces.

Should the patient be in a condition to stand the further operation, a temporary inguinal colostomy—to be closed when the patient recovers—in addition to the perineal operation just described, will increase the chances of recovery by diverting the intestinal contents from the wound.

It not only diminishes the danger of bad sepsis, but it gives a chance of healing without a fæcal fistula, which otherwise results in nearly all cases in which it is necessary to open up the pre-sacral tissues down to the wound in the rectum. In performing the colostomy care must be taken to make the interruption to the passage of the fæces complete, and the closure of the colostomy wound is subsequently carried out in the usual manner (see p. 507).

(b) **Of wounds caused by foreign bodies in the rectum.**—*When the wound is non-penetrating*—that is to say, only injures the mucous and perhaps the sub-mucous coats of the bowel—the condition of affairs will be ascertained by examination with a proctoscope or sigmoidoscope (see p. 522). If there is much hæmorrhage, it may be arrested by tying or under-running the bleeding point, or, if necessary, by leaving a pair of clamp forceps in position should it be too high up for ligature. In many cases it is sufficient merely to cleanse the surface of the wound, to introduce a large drainage tube into the bowel so as to prevent accumulation of gas or fæces, and to leave the injured part to heal.

When the foreign body has penetrated the rectal wall below the peritoneal reflection, the peri-rectal cellular tissue behind it will require free drainage, otherwise septic pelvic cellulitis is almost certain to occur. Drainage is best effected by the perineal route—as already described for similar injuries associated with fracture.

When the rent extends into the peritoneal cavity the shock is less than in cases associated with fracture of the pelvis, but the treatment of the rectal condition is identical. In both cases the performance of a temporary colostomy (*vide supra*) will add to the chances of recovery.

FOREIGN BODIES.

Foreign bodies may find their way into the rectum from above or from below; in the former case they are either comparatively small objects—such as fish-bones—which have been swallowed, or they consist of a gradual accumulation of indigestible material—such as the skins or pips of fruits, cherry-stones, or indigestible portions of vegetables—which form a nucleus on which fæcal material and salts are deposited, and so give rise to the formation of an enterolith.

Apart from these causes, the normal intestinal contents may form a dense hard mass in the rectum, and this condition is most common in elderly persons who are the subjects of habitual constipation. This fæcal impaction may take the form either of one huge mass, which dilates the lower end of the rectum and blocks up the anus like a ball-valve, or of distension of the rectum and a considerable portion of the large intestine with hardened masses which the bowel is unable to pass on.

The other foreign bodies met with in the rectum are those

introduced through the anus, and an enormous variety has been met with—from a small stone or marble up to a large object like a soda-water bottle.

The *symptoms* of a foreign body in the rectum are mainly those of the proctitis produced by it—namely, tenesmus and the passage of blood and mucus. The sharp bodies are apt to injure the mucous membrane and to produce an acute suppurative condition, and frequently cause ischio-rectal abscess and fistula in ano. There may be symptoms of intestinal obstruction if the body is large.

Fæcal masses impacted in the rectum also set up proctitis, which leads to an irritative diarrhœa, with the passage of large quantities of mucus and a small quantity of fæcal material. There is generally some loss of control over the anus, and the patient shows signs of stercoral poisoning and has all the symptoms of chronic obstruction.

TREATMENT.—The removal of a foreign body should be effected as soon as possible, and no special rules need be given. An anæsthetic is generally necessary, and the sphincter should be dilated; the body can then be inspected and removed. Small, sharp bodies can usually be extracted at once by forceps introduced through a speculum when the anus has been dilated. When the foreign body is a jagged object—such as a piece of broken glass—removal must be effected extremely carefully, lest deep-seated injuries to the rectal wall and peri-proctitis should occur. If these objects are large they may be broken up by cutting-pliers and removed piecemeal.

In cases of *fæcal impaction*, the mass must be broken up and removed with a spoon, forceps, or any other suitable instrument, and the débris flushed out with a large enema. An anæsthetic may be called for and it may be necessary to dilate the sphincter fully. The treatment of these cases is of course not completed by the removal of the impacted mass, for the predisposing condition—namely, obstinate constipation—requires careful treatment also. The administration of strychnine and belladonna internally, combined with abdominal massage, is very useful; the daily use of a weak faradaic current, one pole being placed over the sacrum and the other introduced into the rectum, is also very valuable. Dietetic and hygienic rules, for which the reader is referred to medical text-books, must also be imposed. Purgatives are of little value, but benefit may be obtained by the use of pure liquid paraffin (℥ss twice or thrice daily).

CHAPTER XXXVI.

INFLAMMATORY AFFECTIONS OF THE RECTUM.

ACUTE PROCTITIS.

SUBACUTE or chronic inflammation of the rectum is comparatively common. The acute form is rarer and may occur in connection with dysentery, with various operations about the anus or the lower end of the rectum, with injuries from foreign bodies, with ulcerative colitis, or as the result of bacterial infection—most frequently by the gonococcus, either as an extension from the vagina or as the result of pederasty.

The inflammation of the mucous membrane is accompanied by much congestion, and in bad cases results in ulceration or sloughing of the mucous surface. The tendency, however, is towards cure, provided that the exciting cause is removed and proper rest given to the bowel. In very acute cases the infection may extend through the wall of the rectum giving rise to peri-proctitis (see Chap. XXXVIII.). Should the condition persist, it passes into a chronic proctitis, either of the proliferative or ulcerative variety (*vide infra*).

The *symptoms* are distressing heat and weight about the rectum, discomfort in the pelvis, and often considerable pain, accompanied by tenesmus and the frequent passage of small quantities of fæcal material mixed with mucus and often tinged with blood. If the disease is very acute and goes on to sloughing, there may be suppuration from the mucous surface. Irritability of the bladder is also a frequent symptom, whilst the anus is generally painful and may be red. Digital or proctoscopic examination is painful, and a general anæsthetic is advisable for the purpose of making a thorough examination.

TREATMENT.—The first essential is to remove any cause—such as a foreign body or worms. The patient should be confined to bed, and the bowels should be kept open—at first by salines and afterwards by gentle laxatives. For severe pain, suppositories containing two grains of opium with half a grain of extract of belladonna, or an enema of an

ounce of thin starch containing thirty to forty minims of laudanum, may be administered when necessary. Hot fomentations to the perineum and anus, or a hot sitz bath, are very comforting in bad cases. In severe cases the sphincter should be dilated, and if the patient can bear it, irrigation of the rectum with dilute Condy's fluid or boric lotion at the body temperature should be carried out two or three times daily. This is readily done with a douche-can and a soft double-way tube ; the latter is introduced well up the rectum and the can raised about two feet above the level of the pelvis. This will wash away mucus and give much relief. After the irrigation, the skin around the anus should be dried and dusted with a powder composed of equal parts of oxide of zinc, boric acid, and starch. As the disease subsides, general tonic treatment should be employed.

CHRONIC PROCTITIS.

This condition may follow the acute form or it may be chronic from the first ; it may be associated with prolapse or piles. Gonorrhœa of the rectum may pass into a chronic condition and there are also certain non-specific forms of hypertrophic and stenosing proctitis which are chronic in their onset. The most common causes of chronic proctitis are syphilis or tuberculous disease, but these are considered separately (see Chap. XXXVII.).

In chronic proctitis the inflammation may affect only the mucous membrane or it may extend to the sub-mucous tissue, and it usually involves the greater part of the rectum, although the disease is generally most marked at the lower end. The mucous membrane is red and swollen, and there is a somewhat free discharge of mucus from it. Hypertrophy of the glandular tissue, giving rise to papillomatous vegetations, often occurs, and this form is known as *papillomatous proctitis*. After infiltration of the sub-mucous tissue has lasted for some time, the lumen of the bowel may become narrowed ; inflammation and suppuration in the tissues outside the rectum may also occur.

SIMPLE CHRONIC PROCTITIS.

The milder forms, such as occur in connection with foreign bodies or in the neighbourhood of an ulcer of the rectum, are generally limited to the mucous membrane, and usually disappear when the cause is removed. A similar condition also occurs in cases of mucous colitis that have involved the rectum.

TREATMENT.—This is very similar to that of the acute form (see p. 537). The cause should be searched for and removed. The bowels should be kept gently open, and the patient put to bed and confined to a milk diet. The rectum should be frequently irrigated, first with dilute

Condy's fluid or boric lotion, and later with such mild astringents as a solution of perchloride of iron (gr. ij to the ounce), tannin (gr. v to the ounce), or nitrate of silver (gr. $\frac{1}{8}$ to the ounce). In the intervals between the irrigations a suppository containing sub-nitrate of bismuth (gr. xx) and cocaine (gr. $\frac{1}{2}$), is often very useful, and a grain of opium may be added to each suppository if there is much pain. The treatment by *zinc ionisation* (*vide infra*) is useful in the cases associated with mucous colitis.

ULCERATIVE PROCTITIS.

This form of proctitis may occur under various conditions: it may follow traumatism; it may be a sequel to an acute inflammation in which an abscess forms or in whch there is extensive sloughing; it may complicate hæmorrhoids, or it may be part of a general ulcerative colitis. It is also not infrequently found in association with papillomatous or stenosing proctitis. When an ulcer of the rectum has formed just above the sphincter it may remain open for a long time, as the contraction of the sphincter and the accumulation of fæcal material above it retard healing very greatly.

The *symptoms* are not very marked, unless the ulceration involves the sphincteric area. The chief troubles are discomfort, frequent stools, and free discharge of mucus, often tinged with blood. When the ulceration involves the sphincters, symptoms of fissure of the anus may be present (see p. 522). An examination with a protoscope or sigmoidoscope will detect the ulcer, and this should always be used, because the finger may fail to detect a small ulcer if unaccompanied by induration; moreover, it is essental to see how far up the rectum the disease extends.

TREATMENT.—The patient must be kept in bed in the recumbent position, and the bowels should be cleared out at first by a purge and afterwards by laxatives, whilst the diet should consist mainly of milk. Gas should be administered and the sphincter thoroughly stretched, and this should be repeated every few days as muscular power recovers and as long as ulceration persists. It may even be necessary to divide the sphincters in bad cases, but this is a serious procedure which should only be undertaken as a last resort. For the treatment of bad tenesmus a starch-and-opium enema (see p. 536) may be given every three or four hours, and this may be combined with irrigation of the rectum with warm antiseptic solutions, followed by weak astringents (*vide supra*) night and morning as the affection subsides.

Should the ulcers be sluggish in healing they may be touched with solid nitrate of silver through the proctoscope. The action of the caustic should be neutralised after a few minutes by washing out the rectum with salt solution.

When the ulceration is limited to the lower part of the rectum and refuses to heal under milder treatment, it has been suggested to remove the whole of the mucous membrane over the sphincteric area and to detach that above it for some little distance, so as to enable it to be brought down and sutured to the skin at the anal margin—as in Whitehead's operation for piles (see Chap XL.). In extensive cases, with severe pain and no sign of healing, a temporary inguinal colostomy should be performed, after which the sphincters should be kept dilated and the rectum irrigated from the inguinal opening. This will usually allow healing to occur, after which any contraction may be remedied by dilatation with bougies. At a later period the colostomy opening may be closed in the usual manner (see p. 507).

For those cases occurring as part of a general ulcerative colitis, the local treatment of the rectum may be effected by means of *zinc ionisation*. For this purpose the rectum is filled with a solution of sulphate of zinc (gr. x to the ounce), the pelvis being raised so that the fluid passes as high up the bowel as possible. A special rectal electrode connected with the positive pole of a constant current is introduced into the rectum, two flat electrodes connected with the negative pole are placed over the sacrum and abdomen, and a current of 20 milliampères is turned on and allowed to flow for fifteen minutes. The effect of the electrolysis is to force the zinc ions into the deeper layers of the mucous membrane, and good results have been obtained in this way. The treatment is repeated every seven to ten days.

PAPILLOMATOUS PROCTITIS.

This may occur alone, but is usually met with in connection with the ulcerative form. It is characterised by the presence of a large number of warty vegetations which spring from the glandular elements of the mucous membrane and vary much in size and extent. There is no induration about their bases.

The *symptoms* are similar to those of ulcerative proctitis, and the diagnosis is made by the proctoscope; if the vegetations are large they may prolapse through the anus. The condition is generally only a part of a widespread affection of a similar nature throughout the entire large intestine. Malignant disease is very apt to supervene.

TREATMENT.—This is most unsatisfactory, except in the rare cases in which the disease is local. In that case the best way of proceeding is to destroy the vegetations by the thermo-cautery or the galvanic loop. The sphincter should be fully dilated under a general anæsthetic, after which it may be possible to bring down the whole of the affected area through the anus, or to deal with it through a speculum, unless it extends unduly high up. In the latter case it may be necessary to divide the sphincters and the posterior wall of the rectum back to the coccyx in the middle line so as to give access to the upper part of the rectum.

STENOSING PROCTITIS.

This form is usually due to syphilis, but it may occur in connection with other types of inflammation about the rectum. It is characterised by inflammation of the sub-mucous tissue in addition to the ulceration of the mucous surface, and results in atrophy of the mucous membrane, with gradually increasing rigidity of the walls of the rectum and progressive and irregular stenosis, so that the lower end of the bowel becomes converted into a narrow tortuous canal. The condition is usually confined to the lower end of the rectum, but in bad syphilitic cases may reach up beyond the pelvic colon. The bowel above the stricture is dilated and hypertrophied, the amount of dilatation being proportionate to the degree of constriction present.

The first *symptoms* are those of simple proctitis (see p. 537). Later on there is much pain due to ulceration, and symptoms of stenosis appear. The patient suffers from alternate attacks of constipation and diarrhœa, the motions are flattened or like pipe-stems, and there is increasing difficulty in passing them. There is frequent tenesmus, with griping pain in the colon, and the amount evacuated is usually scanty and consists chiefly of muco-pus. In advanced cases there is often some abdominal distension, and, when the terminal portion of the rectum is affected, there may be incontinence of fæces.

These cases may persist for many years. When the condition has lasted for some time, the general health suffers from the fæcal absorption, and the patient becomes sallow, dull, and apathetic, has a bad appetite, and exhales a characteristic offensive odour. As the stricture increases in tightness various complications may bring about death ; the chief of these, such as ulceration and abscesses, are due to sepsis. Obstruction may also occur, but the patient may die from exhaustion before this takes place.

The chief difficulty is to distinguish between a simple stricture and a malignant one, especially that form in which there is an annular constriction without much outgrowth into the rectum. The non-malignant stricture is usually fibrous and elastic to the feel, is very irregular, and may be extensive, while there is not that definite induration characteristic of rectal carcinoma. If the tube of a small sigmoidoscope can be insinuated through the stricture, tracts of normal mucous membrane are seen between the ulcerated areas—a very characteristic condition in simple stricture. The length of time that the affection has lasted is also of importance, the progress being slow in the simple form and a history of some previous inflammatory mischief being usually obtained ; obstruction occurs much sooner in malignant stricture.

TREATMENT.—The treatment is very difficult, but the condition inevitably gets worse if left alone, and therefore something must be done. If the blood gives a positive Wassermann reaction, salvarsan should

be administered at once (see Vol. I. Chap XI.). In the local treatment irrigation with warm antiseptics, zinc ionisation (see p. 539), the employment of laxatives, and the removal of any local cause of proctitis, is the proper line of treatment.

When the stenosis becomes pronounced, means must be employed to overcome it. The main difficulties in the treatment of the stricture are the extreme sensitiveness of the affected part, the irregularity of the stricture, and the serious danger of sepsis following any breach of surface. The latter point is most important, because infective material may pass through the torn wall of the rectum and give rise to a peri-proctitis, which may end fatally, or may lead to the formation of abscess and fistula high up in the bowel if the patient survives.

In slight strictures following injury, extensive pile operations, or

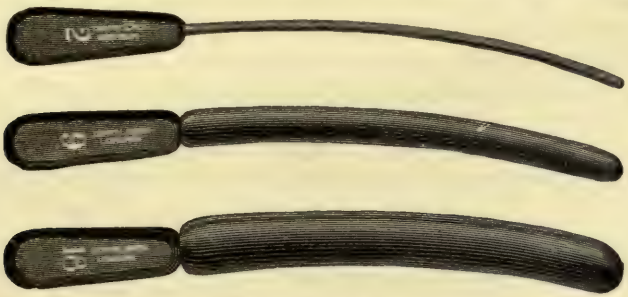


FIG. 182.—METAL RECTAL BOUGIES.

excision of portions of the mucous membrane, the treatment is comparatively easy, because there is no deep ulceration or marked infiltration of the rectal walls ; any cicatricial bands present merely draw the mucous membrane together and often do not involve the other coats.

In some of these mild cases the stricture may be overcome by dilatation with the finger, or with rectal bougies passed through the stricture every two or three days (*vide infra*). When constriction is slight and situated at the anal orifice—as after an operation for piles—a permanent cure may be obtained by excision of the cicatricial tissue followed by suture of the mucous membrane to the skin margins, or by dividing the stricture and suturing the wound subsequently so that the scar is at right angles to the original incision, as is done in pyloroplasty.

In chronic stenosing proctitis, however, the conditions are different ; the ulceration may have healed, leaving an extensive and tortuous contraction, or there may be active ulceration in addition to the latter. The treatment in both cases is difficult and unsatisfactory ; as a rule, it is easier when there is no ulceration, and the surgeon has only to deal with an uncomplicated stricture.

In cases of uncomplicated stricture, *dilatation by bougies* or Hegar's dilators should be employed, a method closely analogous to the gradual

intermittent dilatation of a urethral stricture. The bowels should be well cleared out before the bougie is passed, and the patient should lie on a couch in the lithotomy position. The surgeon takes a well-oiled and warmed bougie of suitable size (see Fig. 182), and tries to insinuate it through the stricture; the greatest gentleness must be observed, and it is probable that only the lowest portion can be dilated at the first sitting if the stricture is a long one. Subsequently, however, more progress can be made, until ultimately the instrument traverses the entire length of the contracted portion. The bougie should be left *in situ* for a few minutes, when—unless it is very tightly grasped—another, the next size larger, is gently passed after the first has been withdrawn. Dilatation should never be pushed beyond what the patient can comfortably bear, and never to such an extent as to tear the surface of the mucous membrane.

At first, three days should be allowed to intervene between the sittings; as dilatation progresses, the interval may be extended up to a week. When full dilatation has been established, the interval may be increased

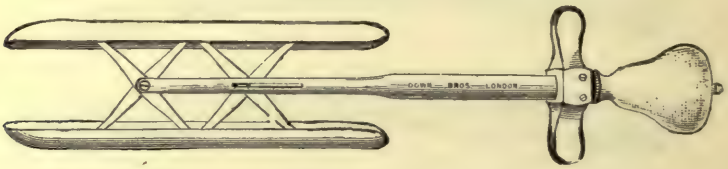


FIG. 183.—RECTAL DILATOR. The blades, which are separated by a screw-action, are parallel throughout.

up to a month if it is found that no fresh contraction has taken place meanwhile. During the entire treatment the bowels should be kept well open, and at each sitting a bougie, one size smaller than the largest passed at the previous sitting, should be used to commence with. The bougies should always be passed by the surgeon himself until the stricture is fully dilated; attempts on the part of the patient might end in serious pelvic cellulitis.

When the stricture is only about half an inch or so in extent, *an expanding rectal stricture dilator* (see Fig. 183) may be used with advantage. The instrument is introduced through the stricture with the blades closed, and the latter are then slowly expanded. The advantage of this instrument is that the dilatation can be increased without having to withdraw one instrument and introduce a fresh one. It is, however, only useful for limited strictures.

Rapid dilatation or forcible stretching or splitting of the stricture has been practised, but cannot be too strongly condemned because, quite apart from the shock, there is a grave risk of septic infection of a severe type. Even if the patient escapes these risks, there is the certainty of increased contraction afterwards.

Internal proctotomy.—This procedure, closely analogous to internal urethrotomy, is of doubtful value except for a cicatrix which only involves the mucous membrane. Division of strictures involving the entire thickness of the rectal wall must lead to the introduction of septic material into the peri-rectal tissues and is not good practice. Electrolysis is apparently of no permanent value.

External proctotomy, or free longitudinal division of the stricture—the incision being prolonged down through the sphincters and the skin of the anus externally—has also been employed. The wound thus made is packed with gauze to prevent it from closing for some time, in the hope that epithelium will spread along the surface and so enlage the calibre of the lower end of the rectum. When, however, healing is complete, the constriction rapidly becomes as bad as ever, and the patient may be in a worse condition than before because the sphincters may not unite.

Excision of the stricture is theoretically the ideal method, but in practice it is not at all successful. The stricture, especially that following extensive syphilitic ulceration, may be so long as to render union of the two ends impossible. The inflammation may spread up to the pelvic colon, the peritoneal surface of which may be so affected that the gut becomes bound down in the iliac fossa and cannot be pulled down. Moreover, the operation is necessarily accompanied by great danger of septic infection. Should infection occur and the patient survive, the inflammation set up in the pelvic cellular tissue is apt to reproduce the contraction. Nevertheless, this method must be carefully considered in any case of limited stricture. Should the operation be decided upon, the best result will be obtained by performing a temporary colostomy in the first instance in order to avoid the risk of sepsis. This will allow the incision to heal without much inflammation and subsequent contraction, and may also avoid the risk of a fistula. When healing has occurred, the colostomy wound can be closed (see p. 507).

The steps of the excision will vary according to the position of the stricture. The operation is most valuable for strictures low down, in which the induration can be removed without injuring the sphincters. It is similar to Whitehead's operation for piles (see Chap. XL.), except that the dissection penetrates more deeply. For more severe cases either the perineal or Kraske's method (see Chap. XLII.) of excising the rectum must be adopted according to the situation and extent of the stricture.

Colostomy.—Should the patient be getting attacks of obstruction, or should the pain and distress be great, and the foregoing methods impotent to relieve the symptoms, colostomy must be performed (see p. 378). This is still more urgently indicated when ulceration accompanies the stricture, and it is then done mainly to allow the ulceration to heal. After colostomy the ulceration heals, the induration about the stricture diminishes, and the latter becomes gradually amenable to dilatation, and therefore in many cases the colostomy need only be a

temporary measure. The situation of the opening will depend on the extent of the proctitis. When the inflammation is limited to the rectum, the ordinary operation (see p. 379) is the proper procedure. When the induration extends to the sigmoid flexure, however, it will be necessary to open the transverse colon in order to get well above the ulcerated area. It is best to make a complete section of the bowel so as to interrupt the passage of fæces completely.

After the colostomy, the rectum should be syringed out both from above and below with mild antiseptic solutions—such as boric acid, Condy's fluid, or sanitas—and after a few weeks a more methodical treatment may be undertaken. Any ulcerated area may be painted through a sigmoidoscope with strong solutions of nitrate of silver or touched with the solid salt melted on the end of a long probe, and gradual dilatation of the stricture must be carried out after healing has occurred. By this treatment, persevered with for several months, the lumen of the rectum may be so much restored that it may be safe to close the colostomy wound (see p. 507).

It must not be expected, however, that this happy result will often occur. Generally the patient will have to go through life with a colostomy opening, but, even so, his condition is much better than before, for he is freed from the constant pain, tenesmus, and obstruction, and in many cases he has as much control over the colostomy opening as he had before over the anus.

When the stricture is complicated with active ulceration the patient's distress is considerable. Diarrhœa, accompanied by the passage of blood, mucus, and pus, is constant and wears out the strength rapidly, and the passage of bougies is very painful. In strictures near the anus the screw dilator (see Fig. 183) every second or third day is more satisfactory than bougies. If the stricture can be fully dilated the ulcers may heal.

In most cases, however, the pain is so severe that the surgeon has to make a choice between colostomy and external proctotomy, and as a rule the former will be indicated. In some of these cases—especially when they are due to syphilis—the surgeon may find the sigmoid flexure so bound down in the iliac fossa that left inguinal colostomy cannot be easily performed: if the sigmoid flexure cannot be detached from its adhesions and brought up to the surface sufficiently to enable the bowel to be cut across completely, the transverse colon must be opened through a fresh incision.

CHAPTER XXXVII.

SYPHILIS AND TUBERCULOSIS OF THE RECTUM AND ANUS.

SYPHILIS.

Primary syphilitic chancre at the anus is not very rare, and occurs more frequently in women than in men. It is generally situated about the anal margin, but may be actually within the rectum—usually in the sphincteric area.

The diagnosis is most important, as the sore may be mistaken for a carcinoma of the rectum. The appearances are almost precisely similar to those of chancre elsewhere, except that, owing to the irritation of the fæces, there is more inflammation and ulceration, and when the chancre is situated well within the anus, the inflammation about the base may be so marked as to suggest malignant disease. One of the chief points of distinction between carcinoma and chancre in this situation is the limitation of the ulceration in a chancre and the absence of the foul, sloughing, irregular surface, which is common in carcinoma. A positive Wassermann reaction may clear up the diagnosis, but in the early stage this may not be present. The glands first affected in chancre about the anus are the inguinal chain; when it is situated within the bowel, the enlarged glands lie in the hollow of the sacrum. In a short time secondary symptoms occur, and then the diagnosis becomes clear.

Treatment. — This is the same as that for chancre elsewhere (see Vol. I. Chap. XI.). Owing to the pain and irritation that the patient suffers, it is important to obtain rapid healing, and therefore salvarsan should be chosen. Locally, suppositories containing calomel and opium —if necessary combined with cocaine—are useful.

In the secondary stage syphilitic affections are frequently met with about the anus; the rectum itself is rarely affected, except in the tertiary period. The typical manifestations are mucous tubercles or condylomata. Condylomata are frequently mistaken for hæmorrhoids, and the small ulcers for fissures of the anus, and very serious results may follow such a mistake; not only is there no necessity for any operative interference in these syphilitic cases, but the discharges are

excessively infective, and it is most important therefore that a clear diagnosis should be made.

The large condylomatous masses are usually situated near the anal orifice, but there is often an interval of healthy skin around the anal margin which at once distinguishes the condition from hæmorrhoids. The condyloma is a sessile, ovoid swelling, with its long axis generally radiating from the anal orifice, presenting a characteristic greyish-white surface and discharging a thin, watery fluid.

Treatment.—The ordinary treatment for syphilis (see Vol. I. Chap. XI.) must be employed, while the best local treatment is to keep the parts dry and clean, and dust them with calomel and starch (calomel one part, starch three). It is also advisable to introduce a pad of boric lint between the buttocks so as to prevent the two sides touching, because the discharges are very irritating, and fresh condylomata may appear at any point of contact. Under this treatment the condylomata may disappear in a few days.

Similar treatment should be used for large mucous patches accompanied by ulceration about the anus, but there success may not be attained so readily, and it may be necessary to stretch the anus and cauterise the ulcer with pure carbolic acid or solid nitrate of silver, because, when ulceration has occurred, a fissure of the anus is apt to persist in spite of the improvement in the syphilis.

The most important syphilitic affections are the **tertiary lesions,** which usually lead to extensive ulceration. The condition is comparatively uncommon about the anus; when it occurs it takes the form of an ulceration, spreading somewhat deeply and irregularly, and leading to serious contraction. A more usual condition is a deep tertiary ulceration of the surface of the rectal mucous membrane, and it is more commonly met with in women than in men. Ulceration may appear at any time between the late secondary and the early tertiary periods, and usually occupies the lower part of the bowel; in the great majority of cases, it spreads from below upwards, and sometimes extends as high as the sigmoid flexure and causes serious obstruction. The fact that the mucous membrane is usually involved right down to the anal orifice is a very important point in diagnosing this condition from malignant disease of the rectum, in which the mucous membrane about the anus is usually unaffected.

The ulceration occurs primarily in the mucous membrane and submucous tissues, but is soon accompanied by marked induration of the walls of the bowel. This condition is one of the chief causes of the extensive ulcerations and stenoses of the lower bowel, to which reference has been made under the head of chronic proctitis (see p. 537). The ulcers usually present clean-cut edges and are very irregular in outline; they bleed and suppurate freely.

Treatment.—In syphilitic ulceration about the anus the treatment must be that suitable for tertiary lesions elsewhere (see Vol. I. Chap. XI.),

combined with the local use of calomel and starch powder (*vide supra*), or white precipitate ointment.

When ulceration occurs inside the bowel, general anti-syphilitic treatment must also be carried out, but, owing to the constant irritation by the fæces, to the spasm of the sphincter retaining the contents of the rectum in contact with the ulcerated surface, and to the tendency to stricture, the condition will seldom heal without local treatment of an energetic nature.

In quite early cases, when there is no marked contraction, the anus may be dilated and salvarsan administered (see Vol. I. Chap. XI.), the motions kept soft by laxatives, the ulcers kept clean, and the rectum emptied by frequent enemata, whilst mercurial ointments are applied to the ulcers. The ointment is conveniently applied by means of grooved bougies, such as Caspar's. The grooves are filled with mercurial ointment, and the bougies are passed up gently and left *in situ* for five or ten minutes so as to keep the ointment well in contact with the ulcerated surface. If preferred, the ointment may be introduced through a tube provided with lateral apertures, which is screwed on to a collapsible metal tube containing the ointment. The ointments most used for this purpose are those of white precipitate, dilute nitrate of mercury, or red oxide of mercury. In addition, it is well to administer some intestinal antiseptic, such as salol (ten grains t.d.s.), and the patient should be confined to a couch for a time. This treatment, however, can only be expected to yield a perfect result when the patient is seen quite early.

When contraction is occurring, the treatment is difficult on account of the combination of ulceration and stricture, and, although an attempt may be made to overcome the contraction by dilatation, it will generally be found in advanced cases that this does harm instead of good, and that it is necessary to perform a temporary colostomy. When this has been done, healing of the ulcers can usually be obtained; the stricture may then be dilated and the colostomy wound closed. Excision of the affected portion of the rectum is not advisable in these cases.

In **hereditary syphilis** affections of the anus are very common. They generally take the form of syphilides and mucous patches leading to excoriations and fissures about the anus. If left untreated, these little cracks or fissures may develop into deep ulcers and give rise to considerable trouble. Condylomata are also met with in the same situation.

Treatment.—This is practically the same as for hereditary syphilis in general (see Vol. I. Chap. XI.) combined with the local application of equal parts of calomel and starch.

TUBERCULOSIS.

Tuberculous disease is not uncommon in the ano-rectal region, and it may commence either externally at the anal margin or internally in the mucous membrane or submucous tissues. Primary tuberculosis of the

skin around the anus in the form of lupus is sometimes met with in association with lupus of the female external genitals. Sometimes a tuberculous ulcer may spread from the anal margin on to the buttock, presenting all the typical characters of a tuberculous ulcer elsewhere; this condition is sometimes mistaken for syphilitic or malignant disease. The ulceration may also extend upwards from the anus to the rectal mucous membrane. The ulcer is generally large and ragged, secreting much pus and giving rise to little or no pain on defæcation. The inguinal glands may be enlarged, and as a rule there is no induration about the base of the ulcer. The progress of the affection is very slow and is often associated with tuberculous disease elsewhere—chiefly in the intestines.

When the disease affects the mucous membrane of the rectum, just inside the anus, the ulceration is very obstinate and may spread through the rectal wall into the ischio-rectal cellular tissue and give rise to an ischio-rectal abscess.

Treatment.—The treatment of *a tuberculous ulcer about the anus* depends largely upon the condition of the patient. When the general health is good and there are no signs of tuberculosis elsewhere, the best plan is to excise the entire ulcer if possible, even when the latter extends into the rectum. This may be done after full dilatation of the sphincter and without dividing it. If excision of the ulcer involves the removal of a large area of skin, the raw surface may have to be covered by some plastic operation. It is very important to get rapid healing around the anal orifice so as to avoid subsequent contraction. Thiersch's skin-grafting may be employed when the raw surface is farther away from the anus. When the patient is feeble and suffers also from extensive internal tuberculosis, or when the disease has extended into the ischio-rectal fossa, such radical treatment as this is often too severe.

Partial excision, scraping, or cauterising with undiluted carbolic or lactic acid, or the application of solid nitrate of silver, may be tried according to the extent and situation of the ulceration. For pain, an ointment containing orthoform and cocaine is the best. Tuberculin injections may also be employed.

In the true rectal form of the disease, when the ulcer has not yet penetrated the wall of the bowel, the anus should be fully dilated and the ulcers, if not numerous, thoroughly curetted and cauterised either with the actual cautery or with lactic acid; occasionally dilatation of the anus followed by the application of a 20 per cent. solution of lactic acid or of ointments containing iodoform or balsam of Peru by means of a rectal introducer (see p. 560) will lead to a cure in the slighter cases. These true rectal cases, however, are very serious and difficult to cure, and the ulcers are often numerous and extensive. We have successfully excised the entire lower part of the mucous membrane and submucous tissues of the rectum, as in Whitehead's operation for piles (see Chap. XL.).

CHAPTER XXXVIII.

PERI-RECTAL INFLAMMATION AND ITS SEQUELÆ.

PERI-PROCTITIS.

INFLAMMATION may spread from the interior of the rectum through its walls into the tissues around, or it may arise primarily in the peri-rectal tissues. There are two forms, both of which end in suppuration—namely, diffuse suppurative peri-proctitis (in other words, septic cellulitis of the pelvis) and localised peri-rectal or ischio-rectal abscess.

DIFFUSE SUPPURATIVE PERI-PROCTITIS.

This generally follows infection from the rectum, but may arise in alcoholic or diabetic persons without injury of the bowel or preceding proctitis ; it may follow the opening up of the planes of cellular tissue in injuries or in operations such as excision of the rectum or division of a stricture.

The cellulitis usually commences above the insertion of the levator ani, and may spread in the cellular tissue in the hollow of the sacrum right up to the iliac fossæ. The tissues become infiltrated with pus, and sloughing occurs rapidly and may be very extensive should the patient survive for any length of time. Death generally occurs from septicæmia or pyæmia. The disease usually sets in early after an operation, sometimes the same evening, and is accompanied by high temperature, delirium, and vomiting. The wound becomes extremely fœtid and assumes a greyish appearance, and the pus is sanious, while the patient gradually falls into the typhoid condition, and death occurs in from three to ten days. This form is closely allied to the idiopathic gangrenous peri-proctitis described by Mr. Furneaux Jordan (*Brit. Med. Journ.*, 1879, vol. i. p. 73).

TREATMENT.—Nothing is of much avail when once the condition has set in, and therefore every effort must be made to diminish

sepsis in operations upon the rectum—a point referred to fully in connection with excision of the rectum (see Chap. XLII.).

The condition when once established must be treated on the lines applicable to diffuse cellulitis elsewhere (see Vol. I. p. 31). The wound must be laid freely open and copious irrigation practised, or, better still, the patient may be kept in a warm bath. Injections of anti-streptococcic serum may be employed, but are frequently powerless, as the condition is often complicated with infection by the *Bacillus coli communis*. Vaccines may also be used, but they seldom do good.

ISCHIO-RECTAL ABSCESS.

This condition is far more common than the last, and the abscess may commence either below or above the level of the levator ani (see Fig. 184). Suppuration is generally due to infection from the rectum and may follow ulcers, fissures, piles, growths, foreign bodies, strictures, or injuries. There are three chief ways in which the abscess may form—namely: (1) by direct extension from a wound or injury of the mucous membrane; (2) from suppurative phlebitis; and (3) as a result of septic lymphangitis.

Ischio-rectal abscess superficial to the levator ani. — More than one variety may be met with. The common form is a small superficial abscess just outside the anal margin, and probably originating in the glands of that region. The pus burrows beneath the anal mucous membrane, and perforation may occur there as well as on the skin externally, the result being the formation of a small superficial fistula.

In other cases the abscess is situated beneath the mucous membrane covering the internal sphincter, and probably results from septic thrombosis of a pile. Here the pus either bursts into the bowel and gives rise to the so-called 'blind internal fistula,' or it may find its way down in the submucous tissue and turn round the lower edge of the sphincter into the ischio-rectal cellular tissue, where it forms an ischio-rectal abscess. Perforation of the mucous membrane usually occurs comparatively early, and then an external opening also forms, giving rise to the ordinary fistula in ano. The swelling and the external opening usually occur in the lateral region of the anus, whilst the internal orifice is generally situated more posteriorly.

Another variety—fortunately a rare one—results from septic lymphangitis in the ischio-rectal fossa. This form is more deeply seated and gives rise to swelling both in the ischio-rectal region and beneath the mucous membrane over the upper part of the internal sphincter. Ultimately the abscess bursts, both internally and externally, and may burrow widely in the ischio-rectal fossa, often opening far out upon the skin of the buttocks and communicating with the internal orifice by a long and tortuous canal. In cases left untreated fresh abscesses

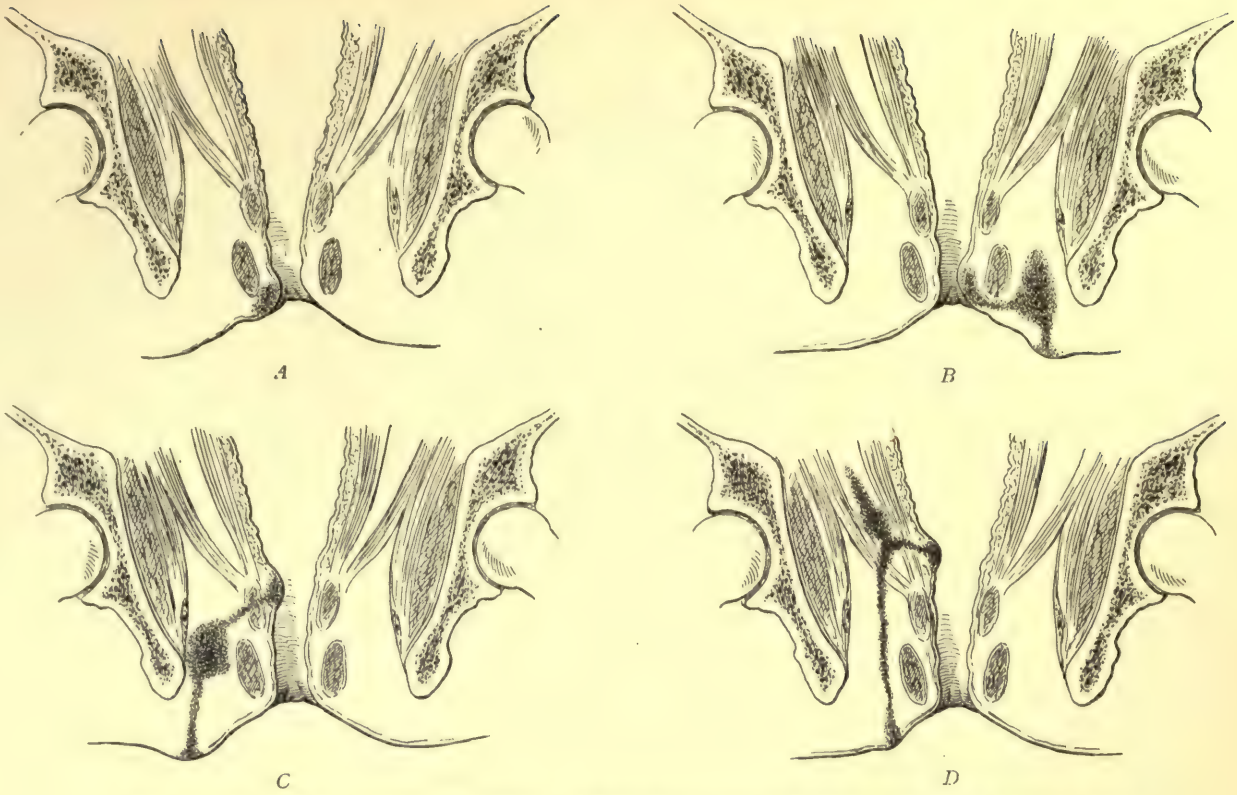


FIG. 184.—THE VARIETIES OF ISCHIO-RECTAL ABSCESS. *A* shows the form in which the abscess is just beneath the skin at the anal margin. In *B* the abscess is situated in the ischio-rectal fossa, and has found its way thence below the external sphincter into the bowel and also directly downwards to the skin. In *C* the abscess is in the same situation but a little higher up, and has found its way into the bowel through the internal sphincter and also to the skin of the buttock. In *D* the abscess has made its way from above the levator ani through that muscle to the skin and also into the bowel above the internal sphincter.

may form, so that eventually there are a number of fistulous openings in the ischio-rectal fossa or on the buttocks, which usually converge to a single track opening into the rectum.

Ischio-rectal abscess situated above the levator ani.—An abscess of this kind may arise either in the peri-rectal cellular tissue or may extend from a stricture or cancer of the rectum or some disease of neighbouring structures—such as the cæcum, the broad ligament, or the prostate. It is usually accompanied by fever, anorexia, and severe deep-seated throbbing, with difficulty in defæcation. The abscess burrows in various directions, generally opening into the bowel above the levator ani, and also extending through the latter into the ischio-rectal fossa and finally bursting through the skin ; the result is that an external opening is formed from which a track runs through the levator ani into the rectum.

Tuberculous ischio-rectal abscesses are not accompanied by symptoms so severe as those of the ordinary acute variety, and may even rupture without having caused the patient any marked discomfort.

TREATMENT.—An ischio-rectal abscess should be opened freely as soon as its presence is detected, in order to avoid the risk of a fistula in ano ; the application of poultices or fomentations only wastes time and allows extension of the disease, and makes the formation of a fistula almost certain. The incision into the ischio-rectal fossa should be made in all cases in a line radiating from the anus, and, when the abscess is deep-seated, the incision should be kept as near as possible to the middle line so as to avoid dividing important structures. In a superficial abscess the pus is reached immediately the skin is divided ; in the deeper-seated ones Hilton's method (see Vol. I. p. 28) may be employed—a finger being placed in the rectum to prevent the risk of the forceps penetrating the bowel. It is generally well to add a second incision at right angles to the outer end of the first—converting the single incision into a ⊥-shaped one—as this allows of better drainage afterwards.

In the ordinary ischio-rectal abscess the pus is very superficial and has so thinned the mucous membrane just inside the anus that it gives way even after the abscess has been laid freely open by an external incision, and a second operation for fistula in ano will thus be required. Hence, when it is found on opening one of these abscesses that the pus has come round the lower edge of the external sphincter, the best plan is to introduce a probe-pointed, flexible director (see Fig. 185) from the opening in the skin to the highest point of the cul-de-sac beneath the rectal mucous membrane, and to push the director through into the bowel, hook the point of it out through the anus, and then divide the bridge of tissue lying upon it. The operation is thus a combination of opening an abscess and slitting up a fistula in ano. The cavity is packed and treated just as an ordinary fistula in ano (see p. 554). This radical treatment is only called for when the pus burrows

round the edge of the sphincter and not when it perforates that structure; here it is worth while to wait and see whether the mucous membrane will recover after the pus has been freely evacuated by an incision external to the anus.

In the deeper-seated forms, whether they find their way down from above the levator ani or not, the abscess cavity should be opened by an external ⊥-shaped incision, all diverticula opened up, and a large drainage tube inserted. The bowels should be cleared out before the operation and then confined for three days, after which they should be opened daily with laxatives. As soon as the act of defæcation is over, the parts

FIG. 185.—BRODIE'S FLEXIBLE PROBE-DIRECTOR.

are irrigated, and a fresh drainage tube is inserted, and this is repeated until the wound becomes superficial. Sterilised gauze and wool should be used as dressings, as antiseptic materials are unnecessary, and apt to set up pruritus ani.

Many of these deeply seated abscesses will heal without perforating the bowel if free drainage is provided before the mucous membrane has become much thinned. Of course if the abscess is secondary to some other disease—such as necrosis of the sacrum—the sinus left will not heal until the original cause is got rid of.

FISTULA IN ANO.

By this term is understood a fistulous track, one end of which opens through the skin and the other through the mucous membrane of the rectum or anus. The term, qualified by the adjective 'blind' is also used when there is only one opening, external or internal—that, is when the condition is really one of sinus and not a true fistula.

Fistula in ano is always preceded by an ischio-rectal abscess, which has generally burst spontaneously. It may be simple or tuberculous in nature, and the exact local condition varies widely. The track may be single and lead direct from the internal to the external opening, or it may be tortuous or have ramifications or, again, there may be several external openings converging to a single internal one.

A fistula once formed has no tendency to heal spontaneously. This is due to several causes, of which the principal are movement of the parts during defæcation and walking, the sluggish venous circulation about the hæmorrhoidal region, and—more important than all—the frequent

entrance of the contents of the bowel into the tortuous and narrow track. When the fistula is tuberculous, the nature of the disease forms an additional hindrance to healing.

The existence of a fistula in ano is easily demonstrated with a probe ; but, before introducing the latter into the external opening, it is important to pass the finger into the bowel and to search for the internal orifice, which can often be detected either as a small depression, or, more usually, as a slight projection from the mucous membrane. The probe can then generally be manipulated along the canal until it emerges through this opening. Unless this precaution be taken, the probe may be pushed through the mucous membrane at some other spot than the true internal opening, which may not be recognised, and thus a portion of the track may escape proper treatment: this is a point of great practical importance.

TREATMENT.—Whenever it is possible—which will be in the majority of cases—the fistulous track should be laid open from its external to its internal opening. This treatment should always be carried out in the muco-cutaneous varieties to which allusion has been made (see p. 550), and also in the ordinary form in which the fistula does not penetrate the external sphincter, but passes below its lower edge and then burrows up beneath the rectal mucous membrane. The operation is done as follows :—

The rectum is emptied by a purgative administered two nights previously to the operation, and the bowels are washed out by a large warm-water enema three or four hours before it. It is best not to give the enema immediately before the operation, because the bowels may continue to act and the manipulations will be much hampered by the escape of liquid material. Even if this does not happen, a stool may occur immediately after the operation and the dressings may be much soiled.

The perineum should be shaved and the patient placed in the lithotomy position with the buttocks well raised on a pillow. The first step is to dilate the sphincters (see p. 573). The mucous membrane of the lower end of the rectum is then everted and irrigated, the internal opening of the fistula is identified either by inspection or palpation, and a Brodie's flexible probe-director (see Fig. 185) is passed from the external to the internal opening. When the point emerges through the internal opening it is hooked forwards with the forefinger and pulled out through the anus, so that a bridge of soft parts lies across it ; this is divided with a knife or scissors. If a Brodie's probe is not at hand, an ordinary probe may be passed through and its point hooked out through the anus in a similar manner ; the bridge of soft parts may then be divided by cutting down upon the probe until the latter is loose.

After the bleeding has been stopped, the next point is to see whether the entire fistula has been laid open or whether diverticula are present,

A careful examination is made, both by inspection and by the probe, and any undermined mucous membrane is slit up with scissors and any diverticulum followed up with the probe and laid well open. Finally, the sinus is scraped with a sharp spoon, or, if the walls are very indurated, the whole track may be excised, after which the surface is sponged with a solution of chloride of zinc (gr. 40 to the ounce) and sprinkled with iodoform. Strips of iodoform gauze are finally laid along the track so as to prevent the edges of the incision from coming together, a half-grain morphine suppository is introduced into the rectum, and a pad of cyanide gauze and salicylic wool is fixed on with a T-bandage.

When put back to bed the patient's legs should be tied together with a small pillow between the knees, so as to keep the parts at rest as much as possible, and he should lie upon one side. A dose of opium should be given the same night both to relieve the pain and to produce constipation, and this may be repeated when necessary. Retention of urine may follow this and other operations upon the rectum; there is, however, no objection to the patient getting up to pass water after this operation, and this is better than passing a catheter. The dressings should be changed on the day following the operation, but the plug should be allowed to remain *in situ* until the bowels act, which should be on the third or fourth day, after the administration of a dose of castor oil. It is well to inject an ounce or more of olive oil just inside the anus immediately before the bowels are going to act, and, in giving this, care must be taken to introduce the nozzle of the syringe against the sound side of the rectum. After defæcation the parts should be washed and a fresh iodoform gauze plug introduced; this should be changed as often as the bowels act.

When changing the plug the forefinger should be well oiled and introduced into the rectum, so as to feel the upper end of the incision and guide the fresh plug into its place. In doing this the finger should be kept pressed against the opposite side of the anus from the wound, and only after it has passed above it should it be turned so as to feel the upper end of the incision; this saves the patient much pain. A probe should then be passed along the track, to make sure that there is no tendency at any point for the surface to close over and reproduce the fistula. Unless great care be employed in dressing the wound, it is quite possible for healing to occur at the surface before the wound has granulated from the bottom, and for the fistula to re-form. In about a fortnight's time granulation is so far advanced that there is little chance of this occurrence and the plugging may then be discontinued, the patient merely wearing a small pad until the wound has healed; in simple cases this will take about four weeks. The patient may be allowed to walk about ten days after the operation.

When there are multiple external openings, a probe should be passed from the external orifice nearest to the opening into the bowel, and the

fistula slit up ; each of the remaining branches should then be laid open from the original track to the skin opening. This procedure gives rise to the minimum amount of interference with the sphincters, and there is little risk of injuring nerves or other important structures. After the track has been slit up it should be scraped and plugged as recommended above.

The above methods are applicable to the great majority of fistulæ met with in practice ; but there are some more difficult cases—such as those in which the track, instead of turning up around the inferior margin of the sphincter, either penetrates it or enters the bowel above it, and this is particularly likely to be the case when the fistula runs from the skin of the buttock through an opening in the levator ani into the rectum

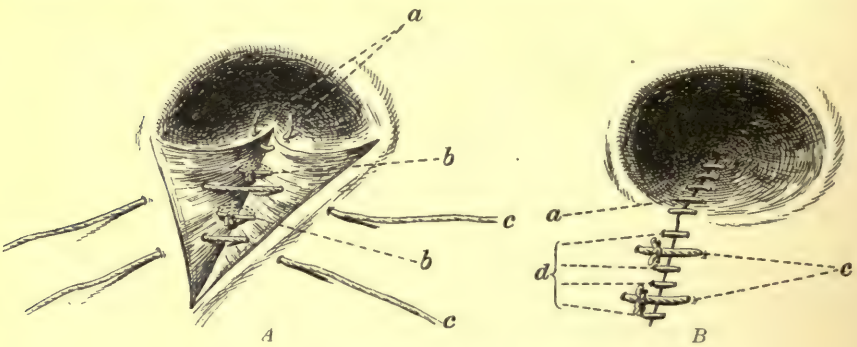


FIG. 186.—DIAGRAM TO ILLUSTRATE THE METHOD OF SUTURING AFTER EXCISION OF A FISTULA IN ANO. In *A* the fistulous track has been laid open into the bowel and entirely excised. The rectal mucous membrane is united by one series of sutures, *a* ; the deep surfaces of the wound by a set of buried stitches, *b* ; while the rest of the wound is brought together by deep silkworm-gut sutures, *c*. In *B* the wound has been closed. The sutures are the same as in *A*, except that an additional set, *d*, is shown, approximating the skin edges.

higher up. In these cases division of the fistula as above described would involve division of both sphincters. This means an extensive operation with much bleeding and a long recovery under treatment by packing. In all probability also it will involve incompetence of the sphincters and incontinence of fæces afterwards—a very distressing condition which must be avoided if possible. Nevertheless, the fistula will not heal without complete division, and, therefore, an extensive operation is essential for a radical cure.

When the patient is able and willing to undergo the operation, *excision of the fistulous track* is probably the best procedure. This is done as follows : The patient is placed in the lithotomy position and the sphincters are fully dilated (see p. 573). A probe is passed along the fistula into the rectum and the tissues are slit up upon it in the ordinary way (see p. 554), leaving a large gap into the bowel. Diverticula from the main track are looked for and slit up until the entire fistulous area is laid open. The

bleeding points are then secured and the lining wall of the sinuses is seized in catch forceps and completely dissected out. The dense fibrous wall usually strips up easily from the loose cellular tissue in the ischio-rectal fossa. Great care must be taken not to leave any portions of the fistulous track behind, and the mucous membrane at the internal orifice must be trimmed so as to leave a firm surface for union. The raw surfaces are now brought together in the hope of securing primary union. Interrupted catgut sutures are first introduced by means of fully curved needles through the divided edges of the rectal mucous membrane so as to invert the mucous membrane towards the lumen of the bowel (see Fig. 186). Buried catgut sutures should then be passed between corresponding points in the deeper parts of the wound so as to bring them together; at the anus, care must be taken to bring the divided edges of the sphincter accurately together. The approximation of the deeper surfaces of the wound is completed by passing two or three stout silkworm-gut sutures deeply through the ischio-rectal fossa by means of a large curved perineal needle; these threads may be either tied in the usual manner or fixed in the form of a quill or button suture. The skin incision is united by interrupted silkworm-gut or horse-hair sutures, a half-grain morphine suppository is introduced into the rectum, and aseptic gauze dressings are applied externally.

After the operation the bowels should be confined for four days, after which laxatives may be given daily. The sutures in the mucous membrane become absorbed or fall into the bowel and do not require removal. If there is redness around the track of any of the cutaneous sutures the suture in question should be removed, and, if any portion of the external wound fails to unite, the aperture left should be lightly stuffed with gauze.

This operation, if carefully done, gives a very satisfactory result. If the raw surfaces are accurately sutured, primary union frequently occurs throughout and the patient is well in two or three weeks' time. Even when failure of union occurs in parts, it is usual for the sphincter to unite, leaving only a small gap to heal by granulation. This method is really the only alternative to palliative treatment, and should replace the old method of free division of the sphincter, followed by healing by granulation from the bottom, as incontinence of fæces is almost certain to follow such treatment.

An operation of this kind is also applicable to fistulæ forming above a simple stricture of the rectum, but when the fistula complicates a malignant stricture, nothing can be done beyond seeing that the external opening is kept free so as to avoid the accumulation of infective material along its track.

When the fistula passes through the levator ani, but is not connected with the rectum, the only treatment—so far as the fistulous track itself is concerned—is to lay it freely open, enlarge the opening through the levator

ani, scrape its walls, and insure proper drainage. If the sinus leads to bare bone in the pelvis, an attempt may be made to treat it appropriately. Should it run to the prostate or the broad ligament, the primary cause must be dealt with according to circumstances. The patient should in all cases be kept in bed until the deeper part of the wound has healed, and the bowels should be regulated.

In tuberculous fistulæ it may also be advisable to attempt a radical cure. When the fistula is situated low down, the track may be divided, its walls completely removed, and the wound packed and made to heal by granulation from the bottom, but in the majority of cases it is essential to aim at healing by first intention, and therefore the operation above described should be employed. Should the fistula be extensive and complicated by numerous tortuous sinuses, or should the patient be in bad health or in the last stages of phthisis, palliative treatment alone must suffice. The track must be properly drained, however, so that infective material does not accumulate in it and give rise to fresh abscesses. The best way of insuring this is to enlarge the external opening and dilate the track right up to the bowel. The sinus is then scraped and packed from the bottom, and the bowels are so regulated that fæces do not accumulate. If this is done, the discharge will diminish in amount and the patient will be much more comfortable, while at the same time the risk of burrowing of pus and the formation of fresh sinuses is diminished.

CHAPTER XXXIX.

FISSURE IN ANO: ECZEMA AND PRURITUS ANI.

FISSURE IN ANO.

By this term is understood a small ulcer or fissure lying just within the external sphincter and extending upwards from the muco-cutaneous margin. It is more common in women than in men and causes much pain, although the lesion itself is trifling. The fissure is generally situated about the posterior commissure of the anus, and by separating the buttocks it is generally possible to see its lower end, which is usually quite shallow, although it may occasionally extend down to the fibres of the external sphincter. At the lower end of the fissure there is often a small projecting tag of mucous membrane called a 'sentinel pile.'

A fissure may arise in various ways. Probably the most common is mechanical detachment of a small piece of the mucous membrane in the act of passing hard fæces; this is torn downwards and causes intense pain. Hæmorrhoids are generally also present. A fissure may also result from undue distension of the anus or from injury—for example, with the nozzle of an enema syringe—and it is not uncommon as a result of a superficial syphilitic ulceration.

The *symptoms* are very characteristic. There is intense cutting or burning pain during defæcation, which lasts for some time after the act. When the pain passes off, the patient is free until the next time the bowels are moved, and in consequence the action is deferred as long as possible, and then the scybalous masses give rise to increased agony. Sometimes the motions are slightly streaked with blood, but there is never the free hæmorrhage characteristic of piles. On examining the patient, the most obvious condition is spasm of the sphincter, which is increased at the slightest touch, so that it is practically impossible to pass the finger through the anus, and no attempt should be made to do so without a general anæsthetic. On separating the buttocks the sentinel pile can

generally be seen, and, by pulling aside the anal folds, the lower edge of the ulcer may come into view ; even without seeing this, however, the condition is so characteristic that no mistake should be made in the diagnosis.

TREATMENT.—The best plan is to administer a general anæsthetic, dilate the anus thoroughly, and insert a large speculum, snip off the sentinel pile, and carry a knife through the base of the ulcer for about an eighth of an inch down to the external sphincter, but not through more than its most superficial fibres ; this should be done with the patient in the lithotomy position. A half-grain morphine suppository should be introduced into the rectum, a little iodoform dusted on the wound, and the bowels kept confined for a few days, after which they are opened daily by a laxative ; as a rule the cure is complete. Simple stretching of the anus may suffice for a cure, but is uncertain. In every case in which examination under an anæsthetic reveals the coexistence of

Fig. 187.—Rectal Pipe for the introduction of Ointments.

hæmorrhoids, they should be operated on (see Chap. XL.) otherwise the fissure is almost certain to recur.

Occasionally the patient refuses operation, and *palliative treatment* must be tried. This is most likely to result in a cure when there is no sentinel pile at the lower end of the fissure and when the latter is only recent and has no indurated edges. The bowels should be kept open daily by the administration of confection of senna (℥j) or equal parts of confection of senna and sulphur (āā ℥ss) every night, and the action of this may be reinforced by a purgative mineral water taken early in the morning. Immediately after the bowels have acted, the parts should be washed with warm water, soap, and a soft sponge ; and an ointment containing ten grains of cocaine, two drachms of carbonate of bismuth, and half a drachm of iodoform to the ounce of vaseline, should be injected within the sphincter by means of a special rectal pipe attached to a collapsible ointment tube (see Fig. 187). If there is much pruritus, extract of belladonna thickly smeared over the anus is useful. If the healing of the fissure is sluggish, an attempt may be made to hasten matters by painting it with a solution of nitrate of silver (two or three drachms to the ounce) ; in recent cases this will often produce satisfactory results. It is, however,

hardly ever worth while to employ palliative treatment in preference to operative measures, as the time spent by the patient and the pain he must necessarily undergo are far greater than if an operation were undertaken.

Should the fissure occur in connection with a syphilitic condylomatous patch, anti-syphilitic treatment must be employed, and, if this is combined with the palliative measures already spoken of, the fissure will often heal, unless it has existed a long time ; should it refuse to heal, the ordinary operative measures (*vide supra*) should be undertaken later.

ECZEMA ANI.

Chronic eczema of the anus is not uncommon when there is some cause of irritation about the anus—such as fissure, piles, worms, acrid discharges, or want of cleanliness. The eczematous condition causes intolerable itching, and the patient scratches the part and increases the trouble, so that in bad cases it is almost impossible to sit, walk, or lie down in comfort.

TREATMENT.—The cause must be removed before anything else is done. Fissures should be treated, piles removed, or worms got rid of and the parts kept clean by washing them with warm water and superfatted soap two or three times a day, drying them by pressure with a soft bath-towel—they must not on any account be rubbed—after which they are dusted with equal parts of boric acid and oxide of zinc, and a piece of boric lint is placed between the buttocks and fixed on with a T-bandage. When the discharge is acrid, a lotion of carbonate of soda may be employed ; when there is much thickening of the parts, 10 per cent. ichthyol ointment is often valuable.

PRURITUS ANI.

This is a most troublesome condition which may or may not be associated with the previous one and which is characterised by intense itching around the anal orifice and over the perineum. Amongst the general causes of the affection may be enumerated gout, diabetes, and errors in diet—especially overfeeding ; whilst occasionally it is neurotic in origin. Among the local causes the most common are constipation, piles, fissure or fistula in ano ; it also occurs in subjects of chronic diarrhœa, and may be set up by irritating vaginal discharges, the presence of worms in the rectum, and sometimes after operations for piles. The itching, which is often present without any visible lesion, is sometimes intolerable, and is generally most marked on sitting down or after going to bed ; scratching aggravates rather than relieves it. After the condition has lasted for some time, the skin may become indurated, cracked, and fissured.

TREATMENT.—This should be both constitutional and local. Any constitutional disease—such as gout or diabetes—must receive appropriate treatment. The amount of nitrogenous food should be reduced, and all highly spiced dishes interdicted. Heavy wines should be given up. The parts should be kept clean in the same way as in eczema of the anus (*vide supra*) and suitable saline laxatives should be administered, Local causes—such as thread-worms, leucorrhœa, or piles—should be got rid of ; and various ointments—particularly 5 per cent. oleate of mercury, or an ointment containing 12 per cent. of chloroform—may be employed. Other useful applications are unguentum plumbi sub-acetatis (to which is added ten to fifteen grains of cocaine to the ounce), lead lotion, or a strong solution of nitrate of silver (a drachm to a drachm and a half to the ounce) painted over the surface every second or third day.

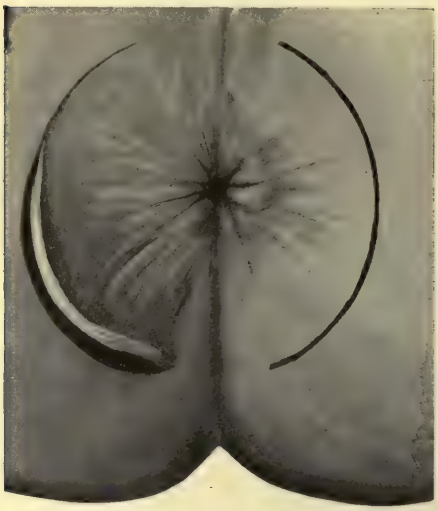


FIG. 188.—BALL'S OPERATION FOR PRURITUS ANI. The incisions are shown, and on the left-hand side the flap is partially dissected up. The skin in the middle line in front and behind the anus is undercut with a tenotome.

Opium should never be given to control the pain as it causes constipation and increases the irritation. If there is much restlessness, chloral, bromide of ammonium or potassium, sulphonal or trional, may be employed. When the skin is hypertrophied, the area may be pencilled with equal parts of carbolic acid and tincture of iodine every other day. If the parts are much fissured as well as hypertrophied, the actual cautery may be lightly applied ; this destroys the terminations of the nerves.

In severe cases more radical *operative measures* are necessary. If the pruritic area is small and localised to one or more spots, it may suffice to enclose them in elliptical incisions and dissect off the skin. The edges of the small wounds thus made are then undercut for some little distance and brought together with silkworm-gut sutures. When the area is extensive, however, the operation introduced by Sir Charles Ball often gives good results. In this operation (see Fig. 188) two semi-elliptical incisions are made, one on each side of the anus and about two inches from its margin. The incisions do not quite meet in the middle line; either in front or behind, and only go through the skin. The crescentic areas of skin between the incisions and the anal margin are then carefully dissected up off the external sphincter until the muco-cutaneous

junction is reached. The little skin bridges between the ends of the incisions in front and behind are undermined with a tenotome, and the skin of the buttock on each side is undermined for a short distance outwards from each incision. The incisions are now brought together with silkworm-gut, and a firm pad of dressing is fixed on by means of a T-bandage. The effect of the operation is to sever the cutaneous nerve endings from their nerves and thus produce temporary anæsthesia; sensation, however, is eventually regained. The wound should not be sutured too closely in case sepsis should occur; if it does, most of the sutures should be removed and warm boric fomentations substituted. The bowels should not be opened until the fourth day.

CHAPTER XL.

HÆMORRHOIDS.

HÆMORRHOIDS, or piles, are varicose enlargements of the terminal branches of the hæmorrhoidal plexus, and form compressible swellings beneath the mucous membrane of the lower end of the rectum or of the skin around the anal margin. The varicosity generally begins at the junction of the superior with the middle hæmorrhoidal veins, but the external piles are caused by dilatation of the inferior hæmorrhoidal branches.

Hæmorrhoids are divided into *external* or *internal*, according to their position relative to the external sphincter, internal piles being situated above, and external piles below it. Frequently, however, the two varieties merge into one another, and hence a third form—the intero-external variety—is often described. Another important classification is into *symptomatic* and *idiopathic* piles, the former being secondary to some other affection, which must be relieved before the hæmorrhoidal swellings will disappear. Any interference with the portal circulation, such as occurs in cirrhosis or malignant disease of the liver, may cause distension of these veins and lead to the production of piles. Similarly, cancer of the rectum, stricture of the rectum or urethra, enlarged prostate, various uterine disorders, and certain forms of heart disease may all produce hæmorrhoids, which, although they cause the patient much discomfort, are not of primary importance and cannot be remedied unless the original cause can be removed. Idiopathic piles are those most frequently met with; they are common in middle life, but rare under twenty years of age, and generally commence about the age of twenty-five when an active athletic life is exchanged for a sedentary one. The affection is as common in men as in women; in the latter, pregnancy is a strong predisposing cause.

Heredity, race, and climate apparently influence the production of piles; Oriental races and dwellers in hot climates, for instance, are said to be more frequently affected than those living in more temperate

regions. Diet undoubtedly plays an important part; heavy feeders not only suffer from engorgement of the portal circulation and consequent congestion of the hæmorrhoidal veins, but in them there may also be direct irritation of the rectal mucous membrane by various articles of diet. Constipation is of importance; it does not act so much by direct pressure on the veins as by leading to ineffectual straining at stool, which causes temporary pressure on the veins and congestion of the part. Prolonged straining at stool is also likely to be followed by slight damage to the anal mucous membrane, which in its turn gives rise to a certain amount of phlebitis and vaso-motor congestion of the parts, and thus brings about the formation of hæmorrhoids.

The *symptoms* may be classified according as the patient suffers from ordinary uncomplicated piles, or from an exacerbation of the ordinary symptoms, usually spoken of as an 'acute attack of piles.' In the latter case the patient may have so little trouble between the attacks that he requires no treatment, and does not even know that he suffers from hæmorrhoids. In other cases—generally after two or three of these acute attacks—the piles remain permanently in evidence, and the patient therefore suffers from the symptoms due to an ordinary uncomplicated attack of piles with occasional exacerbations.

In an ordinary uncomplicated case of piles, the patient is usually conscious of uneasiness, irritation, or itching about the anus, around which are soft compressible swellings which become turgid during defæcation. The pain is only slight and of a dull aching character. Should the patient suffer from internal piles alone, the pain is usually only present when the tumours are protruded through the anus, and disappears when they are returned within it. External piles are soft fleshy masses situated around the margin of the anus, within which they cannot be reduced; bleeding is not common, but cracks and fissures often form in the mucous membrane between them. Internal hæmorrhoids on the other hand are not visible unless they are extruded by straining or unless the patient suffers from a so-called 'acute attack' of piles. They bleed freely, often on the slightest touch, and the blood is generally arterial in character. Bleeding usually only occurs during the act of defæcation, and the blood spirts over the pan in a characteristic manner. This blood comes from the surface of the pile in the form of a capillary oozing; occasionally there may be a minute opening into one of the large venous spaces, and most serious and even fatal hæmorrhage may occur. In these cases, and also when the piles are inflamed and protruding through the anus, bleeding may occur independently of defæcation. There is always a certain amount of mucous discharge and sometimes considerable pruritus.

In an acute attack of piles there is a condition of acute inflammation, practically phlebitis and peri-phlebitis. This usually affects the internal piles and may lead to complete thrombosis of the veins in the piles affected.

Far from curing the pile, this merely produces induration in it and often renders it more prominent in the quiescent intervals, and therefore more likely to be the seat of fresh acute attacks, as it becomes chronically œdematous and thickened. A certain amount of prolapse of the rectum may accompany these acute attacks, but it disappears when the piles are removed.

The piles may slough, or suppuration may occur in them—in both cases as a result of bacterial infection. It is generally held that the *Bacillus coli communis* is responsible for the phlebitis and thrombosis, while the pyogenic organisms give rise to suppuration and gangrene; fistula in ano may result from this suppuration. In the case of an external pile, thrombosis practically always cures the particular pile affected.

Patients who once develop well-marked piles generally remain subject to them for the rest of their lives. With proper treatment, however, piles may disappear almost entirely, but they are apt to recur with any error of diet or hygiene. As long as the affection is slight, the patient may be the subject of both internal and external piles without any marked inconvenience if he takes proper precautions; but when they are large, they frequently protrude externally, and the patient is not only subject to repeated attacks of bleeding, but is liable to inflammation and its various sequelæ.

TREATMENT OF UNCOMPLICATED CASES.

This may be considered under two heads—namely, palliative and radical treatment.

Prophylactic and palliative treatment.—In a number of cases this is all that is required, the essential points being a proper regulation of the alimentary functions and the observance of due cleanliness. Anything that may interfere with the circulation through the hæmorrhoidal plexus should be avoided, particularly those things that cause congestion of the liver. A diet should be adopted which will neither overload the liver nor cause local irritation of the rectum. Alcohol should be taken sparingly, and highly spiced dishes and an excess of nitrogenous food should be forbidden. Constipation is probably the most potent cause of piles, and special attention must therefore be paid to the bowels. This matter is too large to deal with here, and a suitable medical text-book should be referred to; it suffices to say that the diet should be light and should contain articles promoting peristalsis—such as ripe fruits, wholemeal bread, stewed prunes, baked apples, or figs. A laxative should be taken regularly; the best are pure paraffin, cascara, effervescing sulphate of soda, or an aperient mineral water. A useful plan is to prescribe a dinner-pill containing nux vomica, belladonna, and

cascara,[1] to be followed by a dose of one of the aperient mineral waters in the morning, and the bowels should be encouraged to act at the same time every day. The patient should err rather in taking laxatives for too long than for too short a time. It is important to avoid straining at stool as it causes congestion of the parts. Should the patient find that the bowels are not going to act easily, the attempt should be given up for the time and a larger dose of the aperient taken. A sedentary life must also be corrected as far as possible, and suitable exercise should be prescribed for each individual case. A patient who sits for a considerable time during the day should be instructed to use a chair with a hard seat rather than a well-padded one.

Great care must be taken to insure proper cleanliness of the parts and also to avoid accidental injury; the congestion so frequently present renders the latter very liable to occur. When there is marked swelling, the best treatment is sponging with warm water, and the patient should be instructed to encourage the act of defæcation just before taking a warm bath in the morning; this is not only valuable for ablutionary purposes, but diminishes the swelling and irritation; any protruded piles can be returned more easily while the patient lies in the bath. After defæcation, paper should not be employed; the parts should be cleansed with a soft sponge and warm water followed by a douche of cold water; and dried with a soft bath towel. After this, glycerine of tannic acid or lead and opium lotion, or the following lotion should be applied: ℞—Liq. ferri, 1 part; glycerine, 2 parts; water, 3 parts. For the treatment of the bleeding see p. 577.

Radical treatment.—This will vary according as the patient suffers from internal or external piles alone, or the two forms combined, and also according as the condition is complicated or not by the presence of inflammation.

(a) **Of external piles alone.**—It not infrequently happens that the protrusions around the anus are a considerable annoyance to the patient, preventing him from taking horse or bicycle exercise and interfering with proper cleanliness. Moreover, cracks and fissures are apt to develop and to prove very troublesome. Under these circumstances, it is well to remove the piles, seizing each one with a pair of forceps and snipping them off with a pair of scissors curved on the flat. A general anæsthetic should be administered and the patient placed in the lithotomy position, and care should be taken to make the long axis of each incision radiate from the anus, so as to avoid the occurrence of stricture subsequently. Each wound may be sutured with catgut; any bleeding that occurs is easily arrested either by the sutures or by a pad of boric lint kept in position by a T-bandage.

[1] A useful formula is: R—Ext. nucis vomicæ, gr. ½; ext. cascaræ sagradæ, gr. j; ext. gent., gr. iij; or, R—Ferr. sulph. exsicc., gr. j; ext. nuc. vom., gr. ½; ext. belladonnæ, gr. ½; ext. gent., gr. ij.

This operation may also be done under cocaine anæsthesia, but it is far better to give the patient a general anæsthetic, as the opportunity should be taken to dilate the sphincter and examine for internal piles, which, if present, may be removed at the same time (*vide infra*).

If the external pile is inflamed and thrombosed, very acute pain may be caused, especially when it is large, as the parts are so tender that the patient cannot sit, stand, or walk in comfort. The indication is to remove the clot and thus relieve the tension at once, and this may be done by injecting a few minims of a 5 per cent. solution of cocaine into the base of the pile, and then transfixing it with a sharp curved bistoury in a line radiating from the anus, laying it freely open and turning out the clot. The congestion is at once relieved and the pain disappears in a very short time, while there is no bleeding, as the vein is thrombosed. A still better plan is to put the patient under a general anæsthetic and remove the whole pile and clot in the manner recommended above, bringing the edges of the wound together with a suture. There is no objection to doing this, even when there is considerable inflammation about the part. This method has the advantage over mere incision, that it gets rid of the skin-tags that must otherwise occur, and which, in the case of a large external pile, may enclose a fairly large suppurating cavity, which takes some time to heal.

The *after-treatment* is very simple. A pad of boric lint is applied, and is removed in twenty-four hours, when the parts are washed with boric lotion, after which dry sterilised gauze is applied two or three times a day.

(b) **Of internal piles and of the mixed form.**—In ordinary uncomplicated cases it is advisable to employ operative treatment when the palliative measures mentioned above do not relieve the symptoms.

In favour of operation it may be urged that the length of time that the patient is laid up is trivial compared with the time lost by the acute attacks to which these patients are subject, and which necessitate considerable periods of rest for their treatment. Again, hæmorrhoids produce a peculiar mental effect upon the patient and may give rise to much irritability of temper and nervous depression, which disappear entirely after operation, so that the mental relief alone is remarkable. Finally, operation is practically safe and almost painless, and patients are thereby relieved from the attacks of inflammation and strangulation—accidents which are not only painful, but dangerous. We therefore advise that operation should be performed in all cases of iodiopathic piles when the patient is suffering much discomfort, and we consider that operation is imperative when he is losing much blood, when the piles come down as he walks about, and when complications—especially strangulation—are present.

Opinions differ as to the best method of operation. The three chief plans are: complete excision of the pile-bearing area, removal of the piles by the clamp and cautery, and ligature.

Excision of the pile-bearing area (*Whitehead*).—From the theoretical point of view this is the ideal method, as the pile-area is completely removed and primary union should result. The difficulties lie partly in the anatomical conditions and partly in the fact that septic infection cannot always be prevented and may interfere with union. In the method of excision introduced by Mr. Whitehead, the lower inch or more of the mucous membrane is removed, together with the terminations of the hæmorrhoidal plexus, this being followed by suture of the cut edges of the mucous membrane to the skin. The operation is comparatively easy, and is generally followed by primary union without pain or inflammation. On the other hand, the disadvantages are undeniable, although doubtless these diminish as the operator becomes more experienced. Thus considerably more blood is lost in this operation than in the other methods, and therefore the procedure may be serious to those who are profoundly anæmic. Again, stricture around the anal orifice may occur, either as a result of the sutures giving way, as may occur when too much mucous membrane has been excised, and when therefore there is tension on the stitches, or from imperfect suturing at the time of operation. The area immediately around the anal orifice may also become quite insensitive, and very annoying incontinence of flatus and even of fæces may result. Fatal pyæmia has followed the operation, and pulmonary embolism has also occurred. The operation is best suited for vigorous adults in whom the piles are large and numerous. It is unnecessary when only two or three large internal hæmorrhoids are present, or when the chief trouble is external piles.

Mr. Whitehead describes his operation as follows (*Brit. Med. Journ.*, Feb. 6, 1887):—

'1. The patient, previously prepared for the operation, and under complete influence of an anæsthetic, is placed on a high narrow table in the lithotomy position, and maintained in this position either by a couple of assistants or by a Clover's crutch.

'2. The sphincters are thoroughly paralysed by digital stretching, and permit the hæmorrhoids and any prolapse there may be to descend without the slightest impediment.

'3. By the use of scissors and dissecting forceps the mucous membrane is divided at its junction with the skin around the entire circumference of the bowel, every irregularity of the skin being carefully followed.

'4. The external and the commencement of the internal sphincter are then exposed by a rapid dissection, and the mucous membrane and the attached hæmorrhoids, thus separated from the submucous bed on which they rest, are pulled bodily down, any decided points of resistance being snipped across, and the hæmorrhoids brought below the margin of the skin.

'5. The mucous membrane above the hæmorrhoids is now divided transversely in successive stages, and the free margin of the severed

membrane above is attached as soon as divided to the free margin of the skin below by a suitable number of sutures. The complete ring of pile-bearing mucous membrane is thus removed.

'Bleeding vessels throughout the operation are twisted on division. This brief description comprises the several stages of the operation.

'It is better to commence the separation of the mucous membrane from the skin at the lowest point, and deal with the two sides in succession, before completing the circle above, so that any oozing that may occur shall be below the work as it proceeds. The incisions must be made through the mucous membrane, and not through the skin. It is very important that no skin should be sacrificed, however redundant it may appear to be, as the little tags of superfluous skin soon contract, and eventually cause no further inconvenience. If this precaution be taken, there is no fear of stricture.

'The attachment of the mucous membrane and piles to the sphincters is so slight that I either employ the closed scissors as a raspatory, or use my fingers in their separation. The firmest adhesions are always found at the highest and lowest points, where the fibres of the external sphincter converge. With a very little patience the whole of the hæmorrhoidal plexus can be isolated and the membrane drawn down, leaving the external sphincter almost bare and cleanly dissected. Up to this stage of the operation there is practically no hæmorrhage, for, as is well known, the arteries which supply the rectum run immediately beneath the mucous lining, and not in the loose tissue separating it from the sphincters. These are, however, necessarily cut in the next step, which consists in the transverse division of the mucous membrane just above the piles. To prevent hæmorrhage, it is advisable to cut through the bowel by degrees, and twist each bleeding vessel as it is divided. After securing the vessels, before making any further incision in the bowel, I attach the free edge of the piece of mucous membrane first divided to the corresponding portion of skin at the verge of the anus. The procedure is repeated until the entire circumference of the bowel is secured to the skin. By this means I almost invariably secure healing by first intention. For the purpose of suturing the mucous membrane to the skin, I always employ carbolised silk, and I never take out the stitches as I find they come away by themselves without creating the needless alarm to the patient which their removal generally occasions. Indeed, after the operation, there is no real necessity ever to look at or touch the parts again.

'Whilst the patient is still on the table, I introduce into the rectum a suppository containing two grains of extract of belladonna, give the external parts a final dust with iodoform, and place over all a strip of oiled lint, which is retained in position by a T-bandage.

'For the first few days, with highly neurotic patients, I keep a bag of ice in close proximity to the rectum, and I generally recommend a dose of castor oil to be taken on an empty stomach on the morning of the

fourth day. The patient sits up on the fourth day, and is in a condition to resume work within a fortnight.

'I rarely find that the patient suffers much pain after the operation, though this depends chiefly on the nervous susceptibility of the individual. Some aching in the back may be complained of, as in other pelvic operations, but this is generally relieved by change of posture. If the change of posture does not answer, a hot water-bag or hot salt applied to the back will generally give immediate relief.'

We generally employ about twelve to sixteen sutures so as to avoid tension anywhere, and to bring the cut edge of the mucous membrane as accurately as possible in contact with the cut edge of the skin; by doing so the development of granulation tissue in the wound is avoided and less cicatricial tissue is formed. For the sutures, we usually employ catgut,

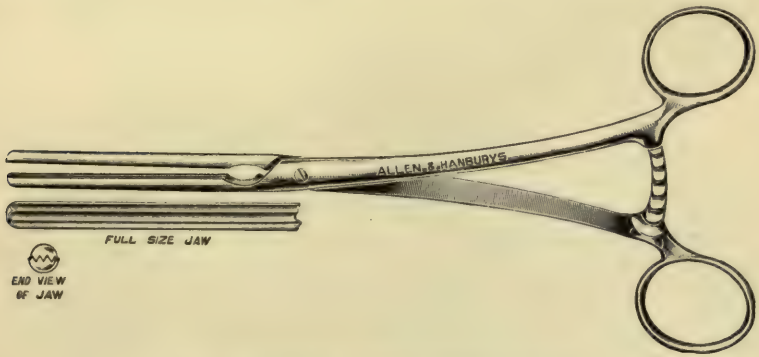


Fig. 189.—Forceps for use in Excision of Piles.

and leave the ends long, so that, should any of the stitches fail to become absorbed or to cut their way out spontaneously, they may be identified and removed. All sutures of non-absorbable material—such as silkworm-gut or horse-hair—should also have their ends left long for subsequent identification. We prefer not to use silk, as recommended by Mr. Whitehead, as it becomes soaked with septic material.

Excision and suture of isolated piles.—When there are only scattered hæmorrhoids with well marked pedicles and healthy mucous membrane between, a good result may be obtained by applying the clamp forceps, shown in Fig. 189, along their bases, cutting off the pile beyond the clamp and then suturing the wound with a running suture of stout catgut. In order to arrest the bleeding with certainty, this suture should be inserted before the clamp is removed. The first suture picks up the mucous membrane fairly deeply just beyond the points of the forceps. Then a running stitch is inserted, taking in the narrow blades of the forceps right up to the opposite end of the wound. When the suture is

complete—but not tied—the forceps are removed and the running stitch pulled quite tight so as to secure all bleeding vessels ; the suture is tied when it is certain that the bleeding is controlled. The after-treatment is similar to that for the clamp and cautery operation (*vide infra*). In our experience this operation is satisfactory for small isolated piles, but it is usually accompanied by more pain than is the clamp and cautery method.

Clamp and cautery.—This is a very useful operation in many cases, and

Fig. 190.—Forcible Dilatation of the Sphincter Ani. The dilatation figured above is that employed as a preliminary to operative procedures in which it is important that the sphincters should be stretched to their utmost limit. For less vigorous dilatation the thumbs may be substituted for the fingers.

has the advantage of removing the piles completely, without the loss of more than a few drops of blood ; it is, therefore, especially applicable in anæmic and debilitated subjects. If properly performed, there should be little or no pain following the operation, and little or no risk of accidental or secondary hæmorrhage, nor is it likely to be followed by contraction. It is unsuited for cases of general hæmorrhoidal dilatation where more than four or five piles require removal. In these cases there is practically no alternative to the operation of excision of the pile-bearing area (*vide supra*). The operation is done as follows :

The bowels having been properly evacuated beforehand (see p. 554), the patient should be anæsthetised and placed in the lithotomy position, the perineum shaved, and the sphincter fully dilated (see Fig. 190). This dilatation should be done most carefully, the muscles being stretched steadily to their utmost limit. The pile-bearing area then prolapses and the number of piles requiring removal is noted and suitable ring forceps

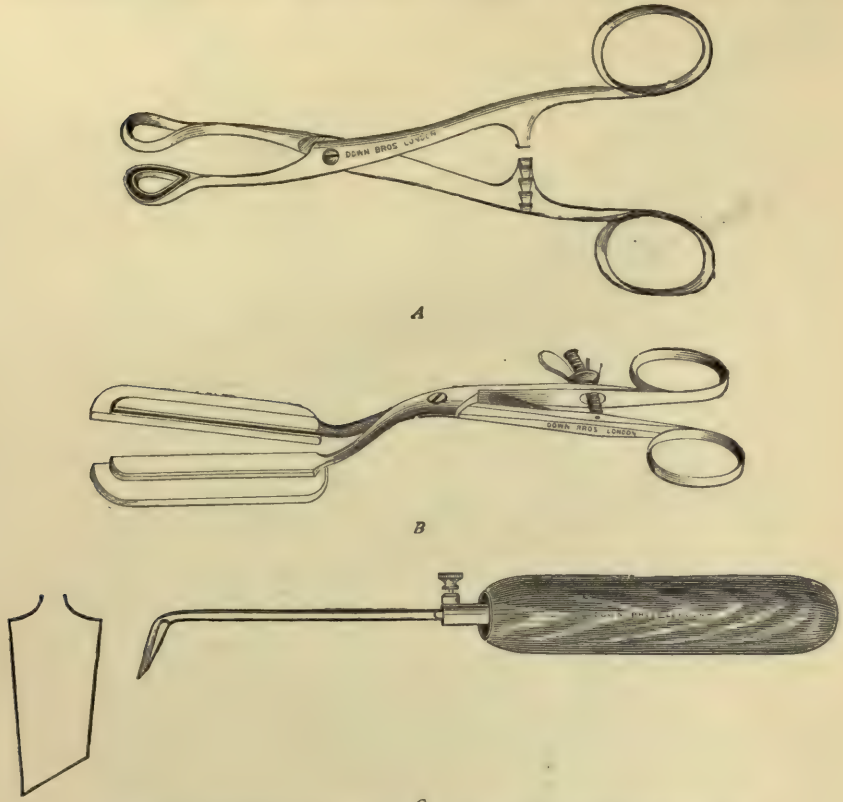


Fig. 191.—Instruments for the Clamp and Cautery Operation for Piles. *A*, ring-forceps; *B*, Smith's clamp; *C*, cautery, with air-jacket round handle to prevent over-heating.

(see Fig. 191, *A*) attached to each. The identification and fixation of all the piles to be removed should be done before proceeding further, otherwise the manipulations necessary to secure the piles may tear asunder the eschars already made by the cautery, and so provoke bleeding. In the female the identification of the piles can be facilitated by introducing a finger into the vagina and pressing the anterior wall of the rectum downwards.

The clamp is now applied to the first pile in such a manner that its long axis is parallel to that of the bowel—a most important point, the

neglect of which may lead to serious contraction subsequently. The clamp employed (see Fig. 191, *B*) should have a powerful screw, and care must be taken in applying it to see that the entire pile is within the grasp of the blades, as, if carelessly applied, a portion of the hæmor-

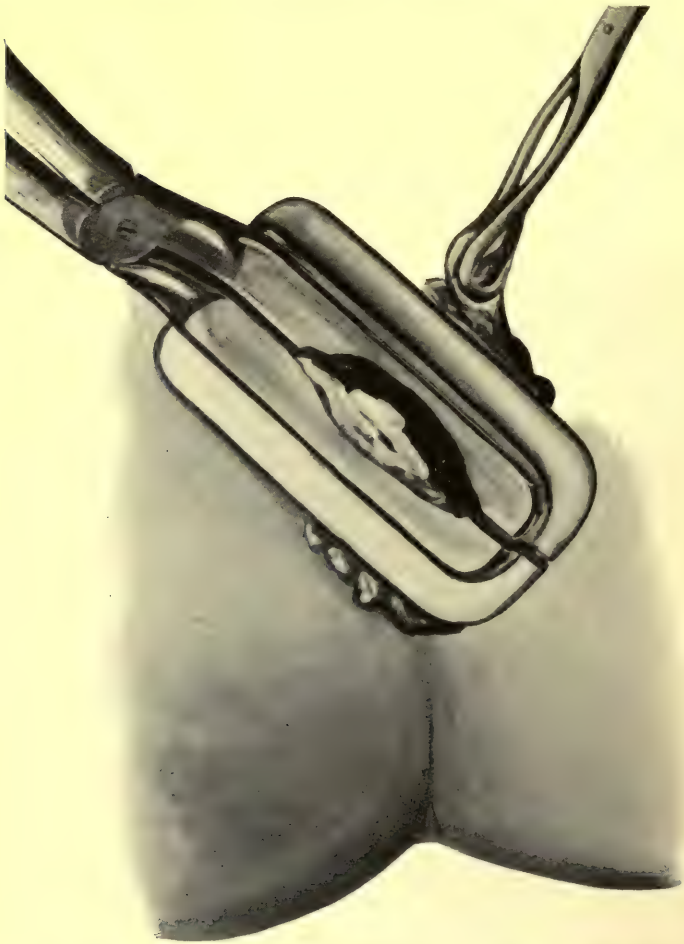


Fig. 192.—The Clamp and Cautery Operation for Piles. *The clamp applied.* Another pile is seen grasped in forceps.

rhoid may project beyond the end of the instrument and may lead to troublesome bleeding. The clamp is screwed up tight, and if the skin margin is included it should be snipped outside the clamp, otherwise pain may follow. Before applying the cautery it is well to smear the buttocks with vaseline so as to prevent scorching, and we have found it a good plan also to place a piece of wet gauze under the clamp so as to protect

the parts still further. A cautery of suitable shape (see Fig. 191, *C*) is then applied at a dull red heat and made to sear off the pile gradually (see Fig. 192). It is best not to snip off the portion of the pile projecting beyond the clamp before applying the cautery, as is sometimes done ; by searing off the whole mass a thicker eschar is obtained, and bleeding is more effectually guarded against. When the projecting portion of the pile has been burnt off, the seared surface is dried and a second cautery at a low red heat is rubbed over it slowly and thoroughly so as to obtain the thickest possible eschar (see Fig. 193), and is the best preventive against bleeding. A Paquelin cautery is unsuitable for this operation, as it is difficult to keep it at the low heat that is required. If a cautery

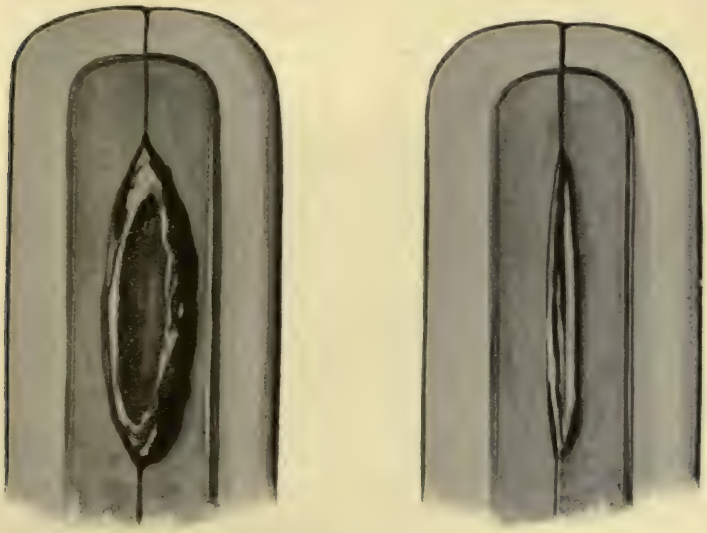


FIG. 193.—THE CLAMP AND CAUTERY OPERATION FOR PILES. *The cauterised pile.* The left-hand figure shows the appearance of the pile after the portion grasped in the forceps has been seared off ; the right-hand one shows the appearance after it has been seared down with a second cautery and just before the blades of the clamp are released.

is used at a higher temperature than a dull red heat it cuts like a knife, does not sear the vessels properly, and there may be troublesome hæmorrhage when the clamp is relaxed. We always heat our cauteries in an ordinary fire or at the flame of a Bunsen lamp.

After the surface has been thoroughly seared, the screw of the clamp is relaxed and the blades are slowly separated so as to allow the base of the pile to escape piece by piece. Should there be any sign of bleeding, the blades can be pressed together again at once and a fresh cautery applied. If, however, the original cauterisation has been efficient, there should be no necessity for this (see Fig. 194). Each of the remaining piles is now removed in turn in a similar manner.

After all the internal piles have been removed, attention is turned to the external ones, which are best treated by picking them up with forceps and snipping them off with a pair of scissors curved upon the flat. The scissors should be applied in a line radiating from the anus, and care must be taken to remove not only the skin, but also the projecting venous mass beneath it. Any bleeding from this source readily stops on pressure, and it is well to unite the edges of each incision with catgut sutures. It is not necessary to remove all the external piles, as they usually shrink up after the operation upon the internal ones; only prominent ones need be taken away.

After the operation is finished the part is carefully inspected to see that there is no bleeding, and a suppository of half a grain of morphine with adrenalin is inserted into the rectum, and a stout india-rubber tube may be inserted for a couple of days so as to allow flatus to escape. A pad of sterilised gauze and wool is then fastened between the buttocks with a T-bandage.

FIG. 194.—THE CLAMP AND CAUTERY OPERATION FOR PILES. *The eschar left when the clamp is removed.*

After-treatment.—The patient is put back to bed and lies on his side with the pelvis raised on a pillow; the bowels are confined for three or four days—opium being administered for this purpose if necessary. During this time the diet should be fluid. On the fourth day a dose of castor oil should be given early in the morning, and just before the action of the bowels occurs, an enema of warm olive oil (3 or 4 ounces) should be administered. The first action of the bowels is often painful, but the oil enema diminishes the pain very much. Should the patient feel faint, brandy or sal volatile may be administered. From this time onward the patient may have an ordinary light diet, while a laxative—such as confection of senna or liquorice powder—should be given every day; immediately prior to each action an ounce of olive oil should be injected into the rectum.

As a rule the disturbance following this operation is very slight. In some cases—especially in men—there is retention of urine, but this is usually transient and causes no trouble; patients may be allowed to stand up for the purpose of passing water if necessary. If there is any pain or spasm of the sphincter, the application of a large sponge wrung

out of boiling water firmly applied against the anus will quickly relieve it. At the end of the first week the patient may be allowed to get up, and he can generally return to work within a fortnight. When there are external piles, and these have not been removed, there may be a good deal of swelling around the anus for some days after the operation; but this soon subsides and the external piles shrink up.

Ligature.—This is a method frequently employed, but it has several disadvantages, which are referred to below. The sphincter is fully dilated, the pile is pulled down by forceps, the mucous membrane around its base is snipped through from below upwards, leaving the pile attached to the bowel only by the submucous tissue in which are the branches of the hæmorrhoidal vessels which supply it. The pedicle is then surrounded by a stout silk ligature and tied very tightly. All the piles are treated in this way and the parts are then returned within the anus. The object of snipping through the mucous membrane before applying the ligature is to diminish pain.

The chief reason urged in favour of this method is the avoidance of hæmorrhage, but in our opinion it does not, on the whole, bear comparison with either of the plans already described. The presence of silk ligatures in a septic area like the rectum must necessarily be a source of irritation and danger, whilst the sloughing of the pile and the separation of the ligature are apt to be accompanied by septic thrombosis and a risk of secondary hæmorrhage. What we have seen of the pain and discomfort following this operation contrasts unfavourably with the results of the clamp and cautery method.

TREATMENT OF HÆMORRHAGE IN CONNECTION WITH PILES.

This may be divided into bleeding occurring as a complication of piles, and bleeding occurring during or after one of the operations for their relief; bleeding in the two latter cases is rare when the operation is properly performed.

Hæmorrhage complicating piles.—This is a mere symptom; the removal of the hæmorrhoids will cure the bleeding. Should the patient decline operation, or be an unsuitable subject for one, it may be necessary to employ local measures for the arrest of the hæmorrhage. For this purpose the ordinary palliative treatment already described (see p. 566) must be adopted, and the use of adrenalin or astringents locally will also be advantageous. Amongst astringents, one of the best is the tincture of hamamelis, diluted with an equal quantity of water, half an ounce to an ounce of this solution being injected through the sphincter and left in the rectum after each action of the bowels. In mild cases injection of cold water or lead lotion may be sufficient, whilst suppositories containing one to three grains of sulphate of iron may be employed in bad cases in addition to the adrenalin and hamamelis.

It is most important to take adequate measures against constipation, which is a prolific cause of bleeding.

Hæmorrhage during an operation for piles rarely causes trouble, provided that the sphincter has fully dilated the sphincter. The area from which the bleeding comes is then always under inspection, as the whole pile-bearing area can be protruded through the anus, and the bleeding point can either be picked up with forceps and tied or be touched with a pointed cautery; more rarely, it may be necessary to underrun the bleeding point. If a cautery is employed, it will be necessary to protect the rest of the circumference of the bowel by means of a large bivalve speculum.

Hæmorrhage immediately after an operation, when the patient has been put back to bed, may prove very serious unless it is recognised early, for very free bleeding may take place into the bowel without any external sign, and the rectum may be enormously distended with clot without the escape of any blood externally. Indeed, the first symptom may be that the patient faints and shows all the signs of severe hæmorrhage (see Vol. I. p. 112). One advantage of leaving a tube in the rectum after the operation is that blood flows out and hæmorrhage is recognised early. It is of cardinal importance to see that all bleeding has ceased before the patient is sent back to bed.

Fig. 195.—Tube en Chemise. The gauze for exerting pressure is packed tightly in between the tube and its petticoat.

When bleeding occurs shortly after the operation, the treatment must be prompt. The patient should be anæsthetised, the sphincters dilated, and all clots turned out of the rectum. In most cases the bleeding can be arrested without much disturbance of the parts by introducing a speculum into the rectum and packing gauze outside it so as to compress the bleeding point. For this purpose the ordinary *tube en chemise* for plugging lithotomy wounds (see Fig. 195) may be employed. This is passed well up through the anus, and gauze is thrust up in the interval between the tube and its surrounding petticoat so as to stretch the sphincter and exert firm pressure against the bleeding spot. The tube is kept in by an ordinary T-bandage, and, after the bleeding has stopped, it is withdrawn by gradually removing the packing—generally at the end of twenty-four hours. If the patient has lost much blood, continuous subcutaneous saline infusion (see Vol. I. p. 112) or an intravenous infusion of the same solution may be necessary.

Some surgeons prefer to identify and secure the bleeding point. As little inflammatory swelling will have taken place, the parts may be

protruded through the anus and the bleeding point actually seen, when it may be suitably treated by ligature, underrunning, or the application of a cautery. This procedure, however, involves much disturbance of the parts and may tear open raw areas.

True secondary hæmorrhage may come on at any period from the fifth to the tenth day, when the sloughs or ligatures are separating. Here the bleeding, although as a rule not so profuse as that occurring earlier, may be so persistent as to place the patient's life in jeopardy within a short time. In severe cases an attempt may be made to secure the bleeding vessel by anæsthetising the patient, dilating the sphincter, everting the parts, and ascertaining where the bleeding comes from. Here, however, there is great difficulty on account of the inflamed conditions of the parts and the fact that the bases of the piles are covered by granulation tissue, and it may be quite impossible to pick up, tie, or underrun the bleeding spot, or even to stop the bleeding by a cautery. Under these circumstances the bleeding areas may be seized in a pair of Spencer Wells's forceps, which are left on and allowed to come away subsequently by a process of ulceration. In most cases, however, the introduction of a tube and packing, as detailed above, will suffice and should be tried in the first instance.

TREATMENT OF COMPLICATED CASES.

Operative.—Any complicated case may be treated by one or other of the operative methods above described. There is no reason to delay operation because a pile is thrombosed or inflamed, and in our opinion it is best to employ the clamp and cautery in all these cases in preference to either of the other methods ; the prolonged searing of the parts shuts off the vessels and there is less risk of absorption than there would be in a clean-cut wound.

Palliative.—Sometimes, however, the patient refuses to be operated upon, or the presence of visceral disease, advanced pregnancy, or some other weighty reason, may contra-indicate operation ; the following palliative measures may then be employed.

When the piles are prolapsed and irreducible, it is of the greatest importance that they should be returned within the anus, otherwise strangulation is very apt to occur. The protruding mass should be sprayed with a 5 per cent. solution of cocaine, after which the patient is placed in the genu-pectoral position, the prolapsed mass is gradually compressed so as to empty it as much as possible, and is then lubricated and pushed inwards with the fingers of one hand whilst the forefinger of the other is passed into the anus to guide it upwards. When the mass has been successfully returned, a pad of boric lint is pressed firmly against the anus and kept in position by a T-bandage applied as tightly as can be borne. The patient should then remain in bed for twenty-four hours at

least, lying upon one side with the buttocks slightly raised upon a pillow so as to prevent the mass coming down again. The bowels should be confined for a day or two.

Should this manipulation fail to reduce the piles permanently, the best plan is to apply repeated hot fomentations, which in this particular region can be done by wringing a soft sponge out of water as hot as it can be borne, applying it to the anus, covering it over with a large mass of cotton-wool and a T-bandage, and renewing it frequently. This method is particularly good for cases in which there is a large inflamed irreducible mass of mixed internal and external piles, and in which any attempt at reduction gives rise to great pain and causes increased inflammation from the spasmodic contraction of the sphincter. Unless this treatment rapidly relieves the swelling, operation should be urged —even in the face of considerable contra-indications—as the risk is much less than that of allowing the piles to become gangrenous, as they probably will.

The treatment of gangrenous piles is identical with that of the inflamed irreducible variety just mentioned, and consists in their immediate removal, or in the application of hot fomentations if operation is refused or thought inadvisable ; morphine will be required to allay the pain. The treatment of isolated thrombosed piles is dealt with on p. 568.

CHAPTER XLI.

PROLAPSE OF THE RECTUM AND ANUS.

By this is meant a protrusion of portions of the mucous membrane or of the whole thickness of the rectum through the anus. When only the mucous membrane protrudes it is termed 'prolapse of the anus'; if the entire wall of the gut comes out, the condition is described as 'prolapse of the rectum.'

The most important cause of these conditions is feebleness of the sphincter ani and an unduly lax condition of the rectal walls, especially of the submucous tissues; sometimes there is also an unduly long meso-rectum. The result is that any straining may lead to protrusion of the bowel, which is increased by the tenesmus to which the prolapse gives rise.

The condition occurs at all ages, but is most common in infancy and in old age. In young children it is generally caused by prolonged straining due to phimosis, constipation, the presence of worms, or the existence of a stone in the bladder, and it is frequently met with in marasmic children —probably as the result of simple weakness of the muscles. In old age it may also be caused by straining—generally due to stone in the bladder, stricture of the urethra, or enlargement of the prostate—but in these cases general weakness of the parts concerned also plays a very important part. The constant coughing and straining that occurs in feeble old people suffering from chronic bronchitis may also lead to prolapse.

In this condition there is a frequent desire to empty the bowel, and the act is accompanied by the passage of mucus and the protrusion of a red, fleshy mass from the anus; this mass usually returns spontaneously when defæcation is accomplished, but it may remain outside and require reduction. The prolapsed mass differs from that formed by piles in that it does not bleed readily, and is marked transversely with the rectal folds, the orifice of the bowel forming the apex of the swelling; there are no projecting masses, such as are seen in the case of piles. Prolapse of the rectum can be distinguished from an intussusception that has travelled down sufficiently far to protrude through the anus,

by the fact that there is no sulcus around the protruded portion in true prolapse ; the latter starts directly from the anal orifice, whereas in an intussusception the prolapsed portion comes down through the anal ring, and a finger can be passed between the intussusception and the anal mucous membrane well up into the bowel.

If the condition remain untreated it gives rise to permanent loss of control from over-stretching of the sphincters. The protrusion becomes thickened and ulcerated, and may become irreducible and even gangrenous.

TREATMENT.—The chief aims are to remove the cause, to reduce the prolapsed portion to prevent protrusion in the intervals between the actions of the bowels, to diminish straining at stool, and to improve the local muscular tone. It is only when these aims are unsuccessful that operative treatment is called for.

(a) **In infancy.**—In the first place any condition giving rise to straining during defæcation or micturition must be remedied. Worms, polypi, hæmorrhoids, or stone in the bladder should be removed ; phimosis or constipation should be treated appropriately, and the general health should be attended to. In addition, the prolapse should always be reduced immediately after defæcation, and measures must be taken to keep it up in the interval. The prolapsed portion should be reduced by gently squeezing and pressing it backwards in the bath or after the parts have been washed with warm water and a soft sponge, and lubricated with oil. Recurrence of the protrusion may often be prevented by fastening the buttocks firmly together with a broad piece of strapping passing across them from one great trochanter to the other. Children with prolapse should evacuate the bowels while lying either upon the back or upon one side, as straining is thus diminished. Every effort should be made to improve the general health ; simple tonic, hygienic and dietetic treatment in conjunction with the local treatment described will cure most cases.

(b) **In young adults.**—The condition is rare in young adults, and is usually the result of stricture of the urethra, piles, or polypi. When these are treated, the protrusion will usually disappear, but the cure may be facilitated by the administration of tonics and the local application of the faradaic current, one pole being placed over the lower lumbar spine, whilst the other is introduced into the anus.

(c) **In old age.**—In elderly subjects there may be not only local causes which are difficult to treat, but also a feeble condition of the patient and a loss of tone in the muscles. In addition, there is often some recurring affection, such as chronic bronchitis, which tends to reproduce the condition. In such cases some form of operation must always be employed. The following are the methods that have given the best results in our hands :—

Linear cauterisation of the prolapse.—This method is only of use when the mucous membrane alone protrudes, and should not be

employed if the entire thickness of the bowel wall has prolapsed. The patient is anæsthetised and placed in the lithotomy position, and the parts are well protruded and the surface of the prolapse dried. Either fuming nitric acid or the actual cautery may be used. If *nitric acid* is employed, longitudinal lines are drawn on the mucous membrane from the margin of the anus to the apex of the protrusion. The acid is allowed to act for ten minutes, and is then neutralised by douching with a solution

FIG. 196.—METHOD OF EXCISING PORTIONS OF A PROLAPSUS ANI. This shows diagrammatically how the elliptical or diamond-shaped pieces are placed. The major portion consists of mucous membrane, the skin around the anus only furnishing a small part. The small diagram in the right-hand lower corner represents the prolapse looked at from above after removal of the portions of skin and mucous membrane. It shows how suture of these incisions not only provides longitudinal cicatrices but largely diminishes the bulk of the prolapse.

of carbonate of soda. The protrusion is smeared with vaseline, and strips of muslin covered with ung. eucalypti are laid over the cauterised area, the protrusion is returned within the anus and kept up by a large pad fastened on by a T-bandage. A morphine suppository is introduced into the rectum and the bowels are kept confined for four days. A purge is then administered, and followed by suitable laxatives daily. The *actual cautery* is more effectual and more easily controlled than nitric acid ; it is applied in a similar manner, and care should be taken that it is only used at a dull red heat. The object of the cauterisation is to provide a series of vertical cicatrices around the bowel, which will contract

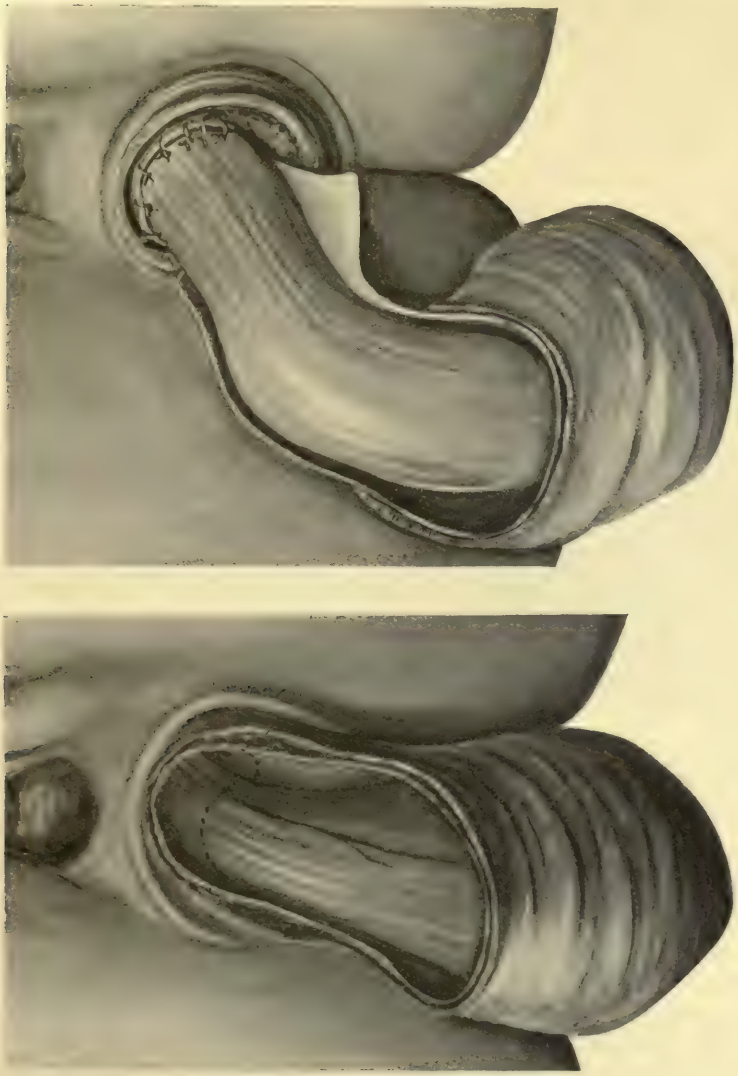
on healing, and shorten the structures in the vertical direction, so as to pull up the prolapse. Both methods may be followed by a painful and protracted convalescence.

Excision of portions of the prolapse.—When the protrusion is large, portions of the mucous membrane of the prolapse and the skin around the anus may be excised, so as not only to diminish the size of the protruded mass, but also to lessen the calibre of the anus, and so form a barrier to the escape of the bowel. This may be done by excising four to six diamond-shaped portions around the anus (see Fig. 196), one part of each diamond consisting of mucous membrane and the other of the skin around the anus. The long axes of the portions removed are parallel to the long axis of the bowel. Generally speaking, a larger amount of the mucous membrane than of the skin is removed, but this will vary according to the laxity of the sphincter. The portions to be removed are marked out with a knife, and are then dissected up from the submucous and subcutaneous tissues respectively; the sides of the incisions thus formed are sutured together so as to convert them into longitudinal cicatrices which will serve to narrow the anus by their contraction. Catgut sutures should be employed for the mucous membrane, whilst silkworm-gut serves for the approximation of the skin. A suppository is inserted, the prolapse reduced, and a pad of lint applied outside the anus. The after-treatment is the same as for the simpler cases (see p. 583). Only the silkworm-gut sutures will require removal.

FIG. 197.—EXCISION OF A PROLAPSE OF THE RECTUM. *The incision.* The prolapse is pulled down by one hand while the transverse incision is made around its base.

Excision of the entire prolapse.—The method just described is suitable for cases in which only the mucous membrane and not the entire wall of

the bowel prolapses. Since by it portions of the mucous membrane only are removed the muscular wall of the bowel may still come down: indeed, the only obstacle to its doing so is the cicatricial contraction



B

FIG. 198.—EXCISION OF A PROLAPSE OF THE RECTUM. *Opening the peritoneal cavity.* In *A* the front half of the prolapse has been cut across, thus opening the peritoneal cavity. The dotted line shows the level at which the prolapse is cut off; before this is done, the cut edge of the parietal peritoneum is stitched all round to the bowel just above this level, as shown in *B*.

produced about the anal orifice. Hence some more efficacious method is necessary in these cases, and the same may be said of those in which there is a large prolapse of the mucous and submucous coats alone. Under such circumstances, the operative methods are either removal

of the entire prolapse, or colopexy. The steps of the operation for excision of the prolapse vary according as only the mucous membrane or the entire bowel wall is involved.

When the mucous membrane alone forms the prolapse, the operation of excision is practically identical with Whitehead's operation for piles (see p. 569). The prolapse having been brought down as far as possible, an incision is made along the muco-cutaneous anal margin, and the sleeve of mucous membrane is dissected up with scissors and fingers until the apex of the prolapse is reached ; the mucous memebrane is then divided in a circular manner, and the cut edge is united to the anal margin as in Whitehead's operation. No traction should be exerted on the mucous membrane ; if the cut edge lies in apposition to the skin around the anus there will be no tension or subsequent stricture.

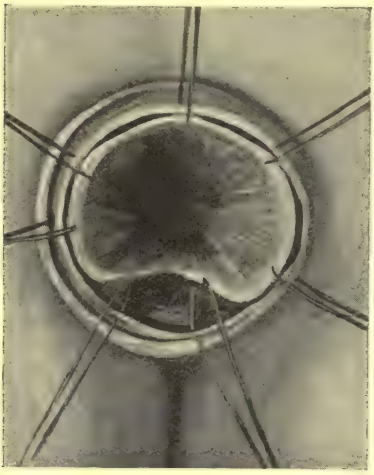


Fig. 199.—Excision of a Prolapse of the Rectum. *Suture of the cut edge of the bowel to the skin.* Below is seen the thick mass of the meso-sigmoid containing the vessels.

When the prolapse involves the whole thickness of the bowel wall, the operation of excision is performed as follows : The patient is placed in the lithotomy position, the prolapse is brought down to its utmost limit, an incision is made along the muco-cutaneous junction, and the mucous membrane is stripped down (see Fig. 197), until the point of attachment of the peritoneum is reached, when the incision is carried through the entire thickness of the bowel wall, and the peritoneal cavity opened (see Fig. 198). The opening must be small in the first instance lest small intestine should prolapse ; elevation of the buttocks, however, will cause the intestines to fall away as air enters the peritoneal cavity. The division of the peritoneal coat is now continued all round, the bowel is gently drawn down as far as it will come, the cut edge of the peritoneum is sutured to the peritoneal coat of the bowel, and the protruding portion of the latter is cut off, the cut edges being sutured to the skin around the anal margin. The best way to suture the bowel to the skin is to divide it by a series of short snips, following each division by suture of the divided bowel wall to the corresponding surface of the skin, and at the same time clamping and tying any bleeding vessels. As a rule there is very little bleeding, except posteriorly, where the large vessels run in the meso-rectum (see Fig. 199). The suturing must be accurately done ; there must be no tension upon the stitches, and care should be taken to draw the

bowel down as far as it will come. The suture material should be stout catgut or silkworm-gut; the ends of the sutures should be left long so that they may be identified and removed subsequently. We have treated several cases in this way with success, and complete control over the bowel has been regained. At the same time the operation is severe and should only be employed for bad cases in which a considerable amount of the entire wall of the bowel is protruded.

Colopexy.—Attempts to shorten the prolapsed portion by suturing the bowel to the abdominal wall have often been made. Unless the operation is done very carefully and very thoroughly the union is apt to stretch and the prolapse to recur. Further, the operation does not affect the portion of the prolapse that is caused by the sliding of the mucous membrane over the submucous tissue, so that, in order to make the operation complete, removal of the prolapsed portion of the mucous membrane must also be carried out if it is not reduced by pulling up the rectal wall.

The operation consists in opening the abdominal cavity just above the left groin, seizing the lower part of the pelvic colon and pulling it up as far as it will go so as to exert traction upon the rectum. The parietal peritoneum is then divided in the iliac fossa, the edges separated, and the bowel laid down over the raw place; the peritoneum is then stitched to it on each side. The suturing must be very carefully carried out over as extensive an area as possible. It is important not to interfere either with the lumen of the bowel or with its blood-supply. The abdomen is then closed in the usual manner, and the after-treatment is the same as after an ordinary laparotomy. Any protrusion of mucous membrane that occurs subsequently must be dealt with separately, the best plan being to remove it, as in Whitehead's operation for piles (see p. 569).

CHAPTER XLII.

NEW GROWTHS OF THE RECTUM.

POLYPUS.

Polypi are generally met with in children, in the lower two inches of the bowel, although they occasionally occur higher up; the majority are adenomata, and are pedunculated, owing to the traction they exert during defæcation. Myomata, fibromata, and lipomata occur, but they are very rare; warty villous tumours and cysts have also been met with. A diffuse polypoid condition of the mucous membrane may also affect the whole of the large bowel from the anus to the ileo-cæcal valve.

The diagnosis is easy when the tumour is situated near the anus; there is tenesmus, accompanied by the passage of mucus and blood, and the tumour may protrude through the anus during defæcation when the pedicle is long; it presents a bright red and fleshy character, and bleeds at the slightest touch. The tumour generally recedes spontaneously after defæcation; sometimes, however, the pedicle is so long that the growth remains outside and becomes deeply congested. When the polypus is situated high up in the bowel the only symptom may be bleeding, but a true intussusception of the bowel may occur, the polypus forming its apex.

When the polypus is low down, the surgeon will feel it with the finger in the rectum, and can make out the presence of a pedicle attached to the wall of the bowel above the pile-bearing area; there should, therefore, be no difficulty in diagnosing it from hæmorrhoids. When, however, the polypus is situated high up, sigmoidoscopic examination will be necessary before the diagnosis can be made.

TREATMENT.—The patient should be anæsthetised, the anus dilated, and the tumour seized and pulled down with pile forceps; it should also be noted whether one or more tumours are present. The pedicle must then be ligatured, and it is important to avoid any possibility of

the ligature slipping, especially when the polypus is large, as that would result in severe hæmorrhage high up in the bowel which could only be reached with difficulty. The pedicle must, therefore, be transfixed with stout catgut and tied in two halves. Transfixion is open to the objection that septic material may become absorbed from the ligature as it traverses the soft parts, and, therefore, we apply a second ligature around the entire pedicle on the proximal side of the first and so prevent any absorption. All traction upon the pedicle must be relaxed during the tightening of these ligatures so as to ensure complete strangulation. When the polypus is situated still higher up it will be necessary to use a suitable snare in order to pass the ligature around the pedicle. After the ligature has been applied the polypus is snipped off, the ends of the ligature cut short, and the patient kept in bed or on a couch for a few days, the bowels being kept confined for two days. After the first action of the bowels the patient may be allowed to get up, and a laxative should be administered every other day.

CANCER.

Cancer of the rectum occurs more often in men than in women; it usually commences after middle life, but may be met with at an early age, in which case the growth is extremely malignant. The typical growth is an adeno-carcinoma, but a squamous carcinoma may spread upwards from the anus into the bowel. Sarcoma is extremely rare.

Cancer of the rectum begins in the mucous membrane—usually on the posterior aspect of the lower end of the bowel—and may form a dense slow-growing ulcerated mass gradually encircling the bowel and leading to marked constriction, or a more rapidly progressing warty tumour undergoing ulceration, and involving a considerable area of the mucous membrane. A long time may elapse before the bowel is completely encircled by the latter form, but obstructive symptoms may occur quite early, and are then due to the large mass filling up the lumen of the bowel rather than to narrowing of its calibre.

The disease infiltrates the muscular coat as it spreads, and ultimately reaches the peri-rectal tissues. Should it involve the peritoneum, it may cause a cancerous peritonitis, or it may spread to other organs such as the ovary, bladder, or other parts of the intestine. When it spreads into the peri-rectal cellular tissue, the intestine becomes fixed in the hollow of the sacrum, and the nerves in the neighbourhood may become involved and severe pain may be set up. Sampson Handley has shown (*Lancet*, 1911) that carcinomatous disease may be found in the wall of the bowel as far away as six inches above the visible limit of the primary growth.

The glands which lie in the fat outside the rectal wall become affected comparatively early, and the infection spreads to the lumbar glands;

the inguinal chain is only affected in cancer involving the anus. Secondary deposits eventually occur in the liver, and this is a common cause of the death of the patient. Secondary growths usually increase more slowly than the primary one, especially when the latter is of the fungating variety.

The *symptoms* depend greatly on the nature and progress of the disease. In the constricting form the earliest symptoms may be those of obstruction, but the fungating form will usually be diagnosed long before any symptoms of obstruction arise. In the latter cases the earliest symptom is a feeling of discomfort about the rectum, accompanied by a desire to go to the closet—especially in the morning, but when the patient goes to stool, only a little mucus mixed with blood and débris is passed, and he experiences the sensation that the bowels have been insufficiently relieved and feels that a second attempt is necessary. The trouble is, however, often so slight that the patient takes little notice of it, thinking that he is merely suffering from some chronic diarrhœa or mucous colitis. In other cases there is alternate diarrhœa and constipation, and generally there are dyspeptic symptoms. One of the earliest characteristic symptoms is that the patient, although quite comfortable in bed, finds a mucous or foul discharge escaping from the anus directly he gets up in the morning. After emptying the rectum he remains fairly comfortable for a considerable time, but often has to seek relief more than once during the day on account of this spurious diarrhœa. When the growth is situated low down, the sphincters become relaxed, and there may be absence of complete control over the motions, accompanied by a continuous mucous discharge from the anus, which is sometimes acrid and may lead to excoriation of the skin ; this discharge is often blood-stained, but profuse bleeding is rare.

Severe pain is usually a late symptom, but when the disease extends beyond the wall of the bowel, the nerves in the hollow of the sacrum may become involved, and the patient then suffers from constant dull aching in the buttocks and thighs, which becomes excruciating as the nerves become more severely compressed.

Digital examination of the rectum may reveal nothing unless the growth is within reach ; when it is, the surgeon feels either a fungating mass confined to one segment of the bowel with healthy mucous membrane elsewhere, or an annular narrowing of the gut, presenting a more or less central ragged opening closely resembling a split cervix uteri. The edges are indurated, and the opening itself is firm, and in many cases the finger cannot be passed through it. When the stricture is high up, the condition known as ' ballooning ' of the rectum may be present, accompanied by a patulous condition of the anus. It is in these cases that an examination with the sigmoidoscope is most valuable ; this should never be omitted in any case of suspected colitis that does not improve rapidly under treatment. True piles may also occur, and should not be

confounded with malignant masses protruding from the anus. It is not uncommon for an ischio-rectal abscess to form and give rise to fistulæ communicating with the bowel at the upper limit of the growth.

In examining the rectum, various points must be investigated, which are of importance as regards treatment. In the first place, the position of the disease has to be ascertained ; this may be done by means of the finger or the sigmoidoscope. In the second, the length of the stricture and its calibre should be estimated, and this may be done in the same way. In the third place, the mobility of the parts, as indicating limitation of the growth to the rectal wall or extension through it and involvement of neighbouring structures, must be noted. This can only be ascertained by the finger when the growth is low down ; if it is situated high up the sigmoidoscope may indicate it, but in most cases the condition is not certain until a laparotomy has been performed. Growths situated low down soon become adherent to the base of the bladder, the prostate, or the vesiculæ seminales in the male, while in the female, adhesion to the posterior wall of the vagina may occur quite early. Undue frequency of micturition or pronounced perineal pain are symptoms of unfavourable import as indicating adhesion Another important point is the relation of the growth to the anal margin ; cancer in this situation usually recurs much more rapidly than when it is situated entirely within the rectum.

TREATMENT.—There are three courses open to the surgeon. In the first place the disease may be left alone because the patient declines operation or because the surgeon thinks that operative interference is out of the question altogether, or that the time for it has not yet arrived. In the second place, a true radical operation—namely, excision of the affected portion of the bowel—may be feasible. In the third place radical treatment may be out of the question, and the surgeon may perform colostomy with the view of preventing impending obstruction or of overcoming obstruction already existing. The first and most urgent point to which the surgeon must direct his attention is whether a radical operation is possible or not, and also whether it is advisable as well as possible.

Cases suited for excision.—The important points in deciding upon the feasibility of a radical operation are the mobility of the growth and its extent. *The situation of the growth* is chiefly important in so far as it may influence the question of the route which should be employed for excision. The mere position of the growth is not now looked on as a very important point as regards a radical operation. A growth situated anywhere in the rectum may be excised readily enough through a laparotomy, sacral, or perineal wound, according to its situation, provided that there are no other contra-indications to its removal.

The relation of the growth to the neighbouring parts and its consequent mobility are most important. As long as the portion of bowel involved is freely movable, it implies that the disease is confined to the rectal wall and has not infiltrated the surrounding tissues. The only exception to

this statement is that possibly the peritoneal surface may be involved while the growth is still freely movable. In most cases, however, if the bowel is mobile we may fairly assume that removal is possible so far as the primary growth is concerned. On the other hand, if the bowel is immobile, or even slightly tethered to surrounding parts, it implies that the growth has passed beyond the bowel wall and is infiltrating surrounding structures, and that the chances of freedom from local recurrence after excision are small. If it is adherent to the hollow of the sacrum, and particularly if symptoms are present which indicate involvement of the sacral nerves, the chances of obtaining a radical cure are very remote. When the growth has only passed beyond the limits of the rectum in front and has begun to involve the prostate, it is no doubt possible to remove it along with a portion of that organ, but it must be admitted that the chances of a radical cure are very slight, and under these circumstances an attempt at a radical operation is only justifiable in a vigorous patient who urgently desires a chance of life and declines palliative treatment.

Involvement of the glands is not necessarily a bar to successful removal of the disease. By using the combined abdominal and perineal or sacral methods an exact operation can be performed, and the glandular area that drains the affected part of the bowel may be taken away. The glands are rarely so extensively involved as to constitute a contra-indication to a radical operation if it is otherwise desirable.

Involvement of the peritoneal coat, though a very serious condition, does not necessarily bar operation if it is slight in extent and if there is no evidence of infection of the adjacent parts. If, however, there is any tendency to dissemination, radical operation is out of the question.

Symptoms pointing to the *involvement of other organs*, more particularly the liver, are also against radical operation. This is, however, not the universal opinion, as some surgeons prefer excision to colostomy—even when the liver is known to be affected—on the ground that the secondary lesions grow more slowly than those in the rectum, and that therefore the patient may have his life considerably prolonged if the local spread of the disease is cut short by excision. There is no doubt that a growing cancer in the pelvis is a source of increasing trouble to the patient and may cause a vast deal of misery before secondary deposits in the liver or elsewhere lead to death, and therefore there is some justification for the foregoing view. In our opinion, however, it is well to regard secondary deposits in the liver or elsewhere as a strong contra-indication to radical operation, except under very exceptional circumstances ; radical operation should never be done in young subjects under these circumstances.

The *presence or absence of obstructive symptoms* has also to be taken into consideration. A patient suffering from intestinal obstruction is clearly not in a suitable condition for a radical operation, although the local conditions may be otherwise quite favourable. The obstruction

must be relieved before extirpation is undertaken; when the patient has recovered, the radical operation may be performed. The same remark applies to cases in which the obstruction is only partial and the bowel above the stricture is much distended. The treatment of this complication involves a preliminary colostomy.

A point requiring consideration is the *general condition of the patient.* Many sufferers from cancer of the rectum are in a state of semi-starvation. They fear to take food because it aggravates the symptoms of obstruction, and they are wasting from the dyspepsia associated with the disease. Many of them, therefore, are unfitted for a radical operation, although the local conditions are favourable; this applies especially to old subjects whose recuperative power is slight and who may therefore die after the operation from mere weakness. If, however, a colostomy is performed on these patients their condition may improve so much that it may be possible to perform a radical operation at a later period.

A consideration of the foregoing remarks will lead to the conclusion that, *in the majority of cases, the best method of treatment cannot be determined unless, and until, the abdomen has been opened.* The exceptions are cases of localised growth, situated in the anal canal or quite low down in the rectum. An abdominal incision has the further advantage that it can be utilised for a colostomy should a radical operation be impossible or should it be desirable to postpone it to a later date when the patient is in a better general condition.

A very important point that the surgeon has to keep before him in all cases is that the severity of an excision of the rectum makes it necessary to see that the patient has a good chance of freedom from recurrence before the operation can be justifiably urged upon him. If an operation is rashly undertaken and it is found impossible to get satisfactorily wide of the growth, the patient at the end of a long convalescence is faced with a recurrence which will entail much greater misery than that which follows a palliative colostomy.

Cases suitable for colostomy.—Should the surgeon decide against the desirability of excision, the next question is whether colostomy should be done forthwith. There should be no question of colostomy *versus* excision when the latter is feasible. Some surgeons urge that directly an inoperable cancer of the rectum is diagnosed colostomy should be performed. The chief arguments in favour of this view are that colostomy relieves the patient of much discomfort and thus renders life more bearable; it is further held that after colostomy the cancerous tumour grows more slowly and may even dwindle in size. The question as to the relief of discomfort is open to discussion. When patients suffer from constant deep-seated pain in the pelvic region this is probably due to involvement of the peri-rectal tissues and the nerves in the hollow of the sacrum, and colostomy will in no way relieve it. On the other hand, when the chief troubles are pain on defæcation, with marked

tenesmus or loss of power over the sphincter, accompanied by constant discharge from the rectum, the operation will ameliorate the condition and should certainly be advised. Another condition calling for colostomy is obstruction, either actual or impending. This subject has already been dealt with (see p. 371). After a properly performed colostomy the health of the patient improves rapidly as a result of the unhindered evacuation of the bowels, and if an abdominal exploration, made at the time the colostomy is done, shows that excision is feasible, it may still be possible to perform it at a later period when the patient's health has improved. A colostomy should therefore always be done when there are signs of impending obstruction and also as a preliminary to an extensive excision where the radical operation is inadvisable for the time being.

On the other hand, as long as a patient suffering from manifestly *inoperable cancer* of the rectum remains comfortable without colostomy, it is very much better that he should continue as he is; he should be kept under observation, so that, if at any time it is found that his colon is not being properly emptied or that obstruction is impending, colostomy may be done without delay. The patient's comfort is materially interfered with after colostomy, and sensitive persons may be intensely upset by it, and, therefore, if this condition is brought about by operation without any tangible benefit to show in exchange for it, the operation is likely to become discredited. We do not lay any stress on the view that a colostomy will lessen the rapidity of the local growth.

Palliative treatment.—Should the patient refuse an operation, or should excision be deemed inadvisable and the time inopportune for a colostomy, palliative measures must be adopted. The diet must be regulated so that the food shall reach the large intestine as completely digested as possible. There is no more fruitful cause of obstruction in these cases than the lodgment of hard, indigestible masses above the growth. Suitable laxatives must be employed, and a good plan is to give the patient a grain or two of extract of cascara every night in a pill, and to follow this up with a dose of an aperient mineral water in the morning, so as to obtain a fluid evacuation daily. This will often relieve the distressing tenesmus. Should there be much pain, opium, morphine, or heroin must be given either by the mouth or as a subcutaneous injection rather than by the bowel, as it is doubtful whether the rectal mucous membrane retains its normal absorbing power. When there is offensive discharge from the growth, irrigation with weak sanitas, permanganate of potash, or boro-glyceride solutions are useful. When there is much oozing of blood from the growth, rectal injections of half an ounce of tincture of hamamelis with an equal quantity of water may be tried. The general health must be attended to and the patient should be encouraged to interest himself in his ordinary pursuits as much as he can without exhausting himself.

Quite recently *radium* has been used in these inoperable cases with the view of destroying enough of the growth to restore the lumen of the bowel to some extent and thus obviate obstruction. For this purpose the radium is enclosed in a suitable capsule and is introduced well into the centre of the growth by means of a proctoscope or sigmoidoscope; a tube containing 100 milligrammes is generally used. It is then packed in place by swabs and left *in situ* for twenty-four hours. Radium does not cure cancer of the bowel, but it certainly does sometimes destroy enough to restore the lumen for a time. It is, however, very uncertain in its action, and fatal perforation of the bowel may occur.

An active patient treated in this way will be much happier than if colostomy were performed at a comparatively early stage of the disease, and will be much more ready to submit to the operation when its performance is essential. The average duration of life after colostomy, performed fairly early in the disease, is from a year to eighteen months; but occasionally cases occur in which several years elapse before death takes place. We have had cases living as long as six or seven years after the operation, but the latter part of these patients' lives is often very distressing as they become bedridden and suffer much from involvement of other organs, especially the bladder.

Operative treatment.—Excision.—Excision of the rectum may be performed in any of the following ways: (1) by the perineal route; (2) by the sacral route; (3) by the vaginal route; (4) by the abdominal route, or by the combined abdominal and perineal or sacral routes.

Preliminary measures.—Certain preliminary measures must be taken in order to minimise the risks of the operation, particularly that of septic infection of the pelvic cellular tissue. Most surgeons think that this danger is best avoided by performing a preliminary colostomy some days before the radical operation is undertaken; it has the additional advantage that it allows the state of the growth to be made out accurately from above. Its influence in producing asepsis of the excision wound is, however, only partial as, although fæcal matter does not pass over it, mucus and intestinal discharges containing plenty of organisms certainly do. It has, nevertheless, a distinct advantage in the operation by the sacral route in that it prevents gross fouling, while in the combined methods it is essential, as the whole lower part of the rectum is removed. The only cases in which it is not necessary are those suitable for perineal excision, in which the growth is situated so low down that, after the excision, it is possible to stitch the cut end of the bowel to the margin of the anus, and those suitable for operation by the sacral route in which an anus is made in the sacral region. Even in these cases, however, a temporary colostomy may be done with advantage, but the opening must be made as high up in the sigmoid as possible, otherwise the shortening of the rectum may interfere with the lower end being pulled down by tethering the bowel at the colostomy opening. In these cases the

abdominal incision will be also of value by enabling the surgeon to decide whether excision is possible or not.

Before proceeding to excision, the colon must be emptied as thoroughly as possible by the administration of laxatives—particularly salines, and frequent enemata. It is well to wash out the rectum twice daily with sanitas or some other non-irritating antiseptic solution for a few days before the operation, but it is a mistake to imagine that anything like true disinfection of the bowel can be obtained in this way. In all cases in which the lower end of the bowel is to be removed, the anus should be tightly closed by stout silk sutures at the beginning of the operation.

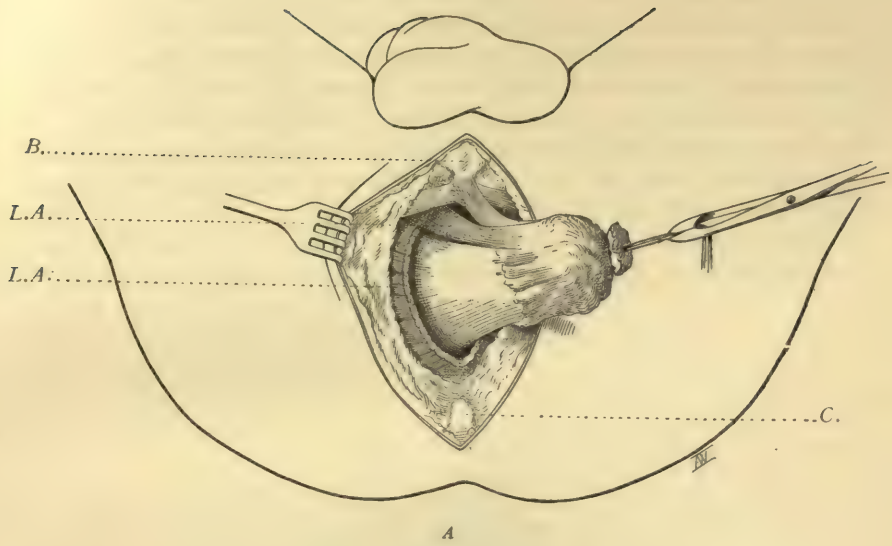
While shock is not a very marked feature of these operations, except in the intra-abdominal forms, it is important to employ all the ordinary safeguards against it (see Vol. I. p. 118). The subsequent steps of the operation vary according to the route adopted.

1. Excision by the perineal route.—This was the method always employed until the introduction of Kraske's operation, but it is now seldom used, except in certain special cases, owing to the difficulty of removing the affected glands and a sufficient length of the bowel. In some cases, in which the growth is within two inches of the anus, however, the method may be employed.

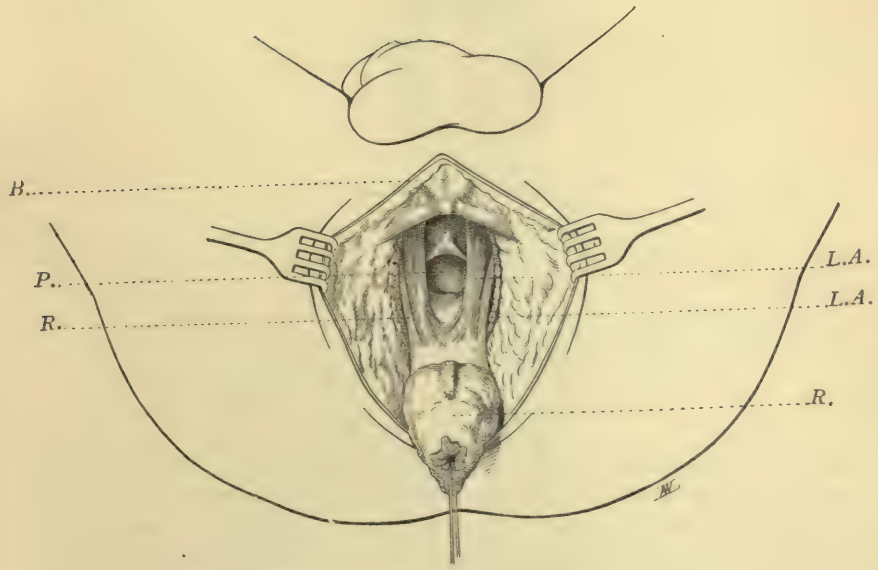
When the growth involves the anal margin the original method may be employed ; the parts are shaved and disinfected as thoroughly as possible, and, after the anus has been sewn up, an incision is made around it so as to enclose it in a wide ellipse. It is then cleared and removed, together with the sphincters and as much of the bowel as necessary, by deepening the incision into the ischio-rectal fossa on each side. Bleeding vessels are caught as they are divided, and, when the bowel has been dissected free of its surroundings well above the limits of the growth, it is cut across transversely and left at the bottom of the wound, which heals by granulation. The peritoneum is not opened. The inguinal glands on both sides should be removed, either at the same operation or at another one ten days later. The wound is lightly stuffed, and, after it has granulated well, bougies must be passed at regular intervals in order to prevent stricture.

When the growth is situated inside the anal canal a more extensive operation will be necessary as the bowel must be divided several inches above the upper limits of the growth. For this purpose the following method may be employed :—

The patient is placed in the lithotomy position, the anus closed by sutures, and a median incision made from the tip of the coccyx to the mid-point of the perineum, diverging on each side so as to enclose the anus in an elliptical incision. The incision from the anus to the coccyx should be carried deeply into the hollow of the sacrum ; a large sponge thrust into it will check hæmorrhage. The limits of the rectum are now defined and the surrounding structures are separated from the gut, care



A



B

FIG. 200.—DIVISION OF THE LEVATOR ANI IN EXCISION OF THE RECTUM BY THE PERINEAL ROUTE. In *A* the sphincteric area has been freed and the lateral fasciculi of the levatores have been cut through. There remain the anterior bundles, which are put on the stretch and divided, as shown in *B*.

C. Coccyx. *B*. Bulb. *L.A*. Levator ani
P. Prostate. *R*. Rectum. (*Hartmann and Quénu*.)

being taken to keep well away from the wall of the bowel. All the fat and glands should be removed from the hollow of the sacrum, and there should be no hesitation in removing the coccyx if it is necessary to get more room. The separation of the bowel is easily accomplished behind and on either side as far as the levator ani ; the connection in front with the vagina or the prostate and urethra is, however, very intimate, and great care must be taken. A finger in the vagina or a large sound in the male bladder will help considerably.

The next step is to divide the levatores ani all round (see Fig. 200), any vessels being picked up as they are divided. The rectum can now

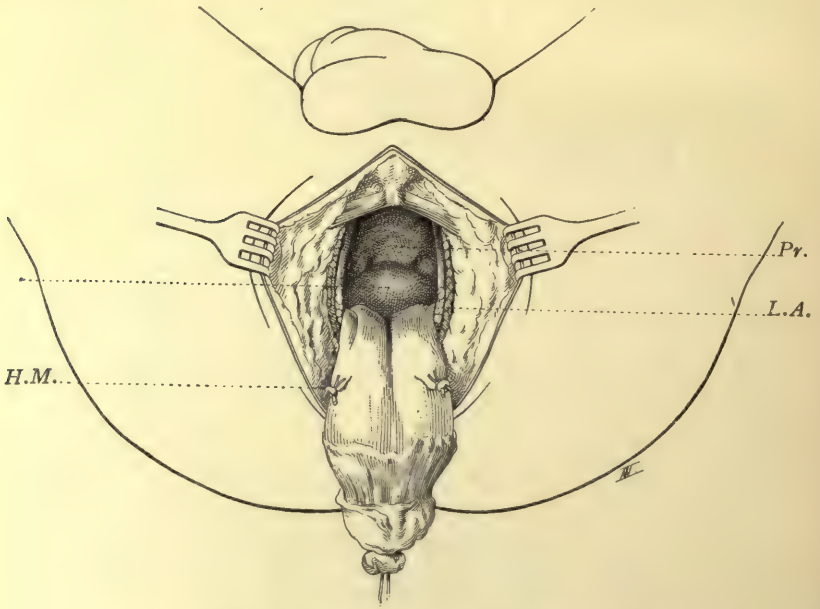


FIG. 201.—SEPARATION OF THE PERITONEUM FROM THE FRONT OF THE RECTUM IN PERINEAL EXCISION. The levatores ani have been divided, the middle hæmorrhoidal arteries tied, and the bowel separated from the prostrate.
Pr. Prostate. *Pe.* Peritoneum. *H.M.* Middle hæmorrhoidal artery.
L.A. Levator ani (divided). (*Hartmann and Quénu.*)

be pulled down more freely, the separation being carried out very carefully in front—chiefly with the right forefinger—so as to strip up the peritoneum as far as possible. The cul-de-sac of the peritoneum is now opened, a tampon of gauze thrust in, and the isolation of the bowel proceeded with. The bowel is then drawn through the anus and, when it has been freed sufficiently, the parietal peritoneum is stitched to the sero-muscular coat well above the point of section.

The situation of the new anal opening is now decided upon. Formerly, the bowel was brought down to the normal position, and if any portion

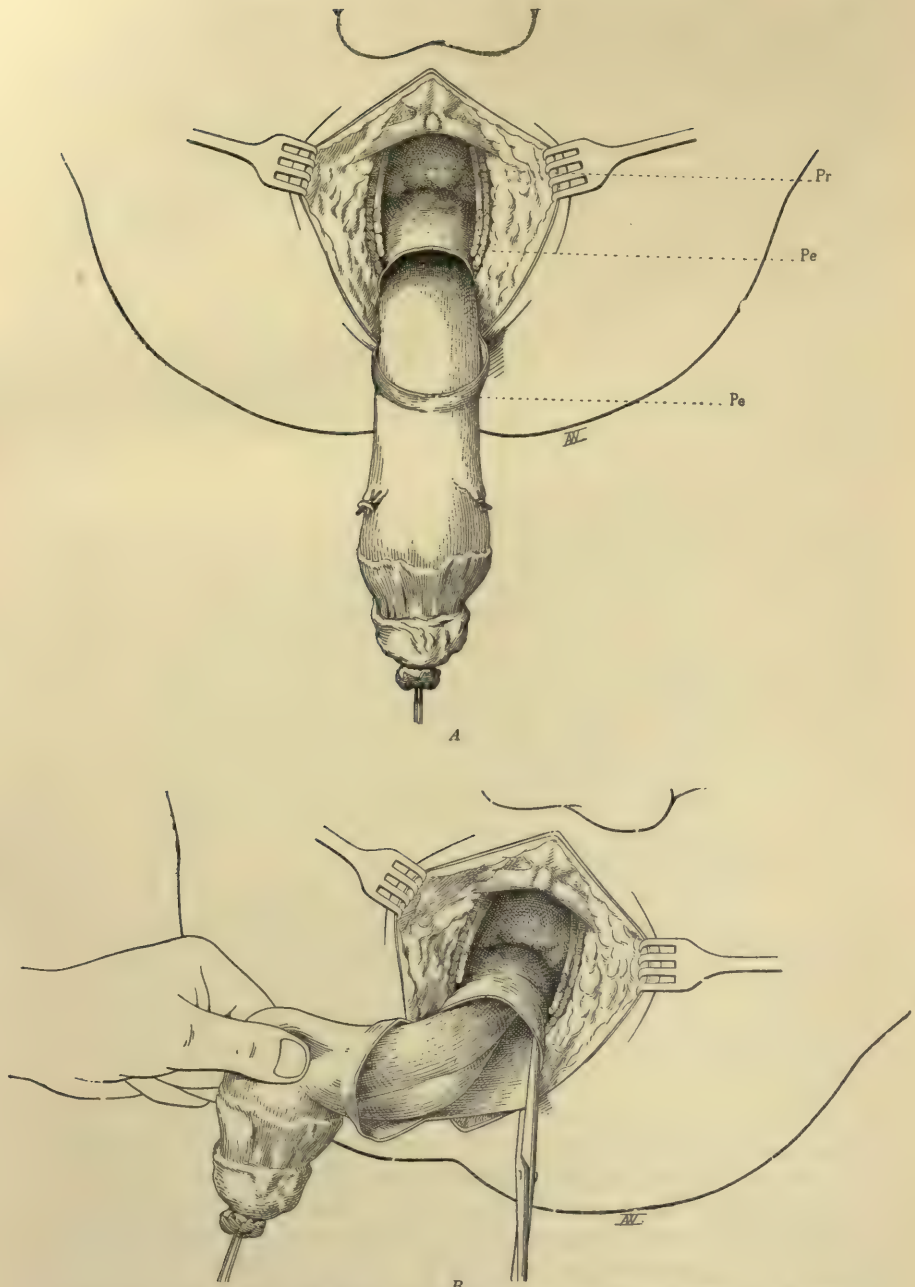


FIG. 202.—TREATMENT OF THE PERITONEUM IN PERINEAL EXCISION OF THE RECTUM. In *A* the peritoneal cul-de-sac has been opened, while in *B* the lateral reflections are freely divided, allowing the bowel to be drawn well down. Before the rectum is cut across above the growth the cut edge of the peritoneum (held in forceps in the figure) is sutured to the sero-muscular coats of the bowel as it is held in the position depicted above. (*Hartmann and Quénu.*)

of the sphincter has been retained it is of course important to do this. If, however, the sphincter has been entirely removed—as will practically always be the case in the operations for cancer at the lower part of the rectum—there is no necessity for making the opening so far forward, and, as a matter of fact, the patient will be able to keep himself cleaner and manage himself better if the opening is somewhat farther back. When the opening is in the normal position, the buttocks prevent the application of any apparatus—or, indeed, of efficient pads—and, in the female especially, the parts are always soiled with fæces. If, however, the opening is made in the coccygeal region it is more accessible, and pads can be efficiently employed and the perineum kept clean. In this operation the opening is not so far back as in Kraske's operation and the patient can generally manage it himself. The opening in this region has the additional advantage that more of the bowel can be removed—a point of great importance in all operations for malignant disease.

When the new anal opening is to be at the posterior part of the wound the anterior part of the latter is closed with silkworm-gut sutures. When there has been no soiling of the wound, drainage is unnecessary, and it is a great advantage if it can be avoided, as any opening left may allow entrance of fæces when the bowel begins to act, and this may give rise to suppuration in the deeper parts of the wound. If, however, there is reason to suspect that the wound has become soiled—*e.g.* from accidental puncture or tearing of the bowel—a drainage tube must be inserted and brought out as far as possible from the new anal opening. If no sign of sepsis appears, this tube may be left out after three days and the opening closed by a stitch inserted at the time of the operation.

The final stage of the operation is the formation of the new anal opening. Before inserting any stitches it is well to give the bowel a half or three-quarter twist around its own long axis, as recommended by Gersuny; this renders the escape of the fæces somewhat more difficult and thus helps to prevent constant discharge from the anal opening. The wall of the bowel is now attached to the margin of the opening in the skin by silkworm-gut sutures which pick up the serous (if present) and muscular coats of the bowel, but do not perforate the mucous membrane.

This procedure leaves a large portion of the rectum (including the diseased tissues) hanging out of the closed wound; so far, there has been no escape of the intestinal contents and no soiling of the wound. The problem remaining is to remove the diseased portion and at the same time to prevent soiling of the wound with fæces for as long a period as possible. This may be done in two ways. In one a silk ligature is applied around the bowel about an inch below the attachment to the skin and drawn tightly so as to constrict the bowel completely. The wound is now protected with gauze and the bowel cut across about half an inch below the ligature. The exposed mucous membrane is rubbed

over with pure carbolic acid so as to render it aseptic for a time. The actual cautery may be employed both to cut the bowel across and to sear the lower end afterwards, but it is apt to burn the silk ligature; if it is used, a clamp must be employed and the ligature applied afterwards. The ligature becomes detached in about four days, but up to that time it prevents the escape of fæces from the bowel, and healing will have advanced very considerably in the wound, and thus the chances of extensive septic infection are much diminished. We have had several cases in which healing by first intention has taken place throughout. The disadvantage of this plan is that the patient may have considerable inconvenience since flatus cannot escape, but this is not as a rule very serious if the bowels have been well cleared out before the operation; if it becomes unbearable the ligature can always be cut across and removed. The other plan is to cut across the bowel, taking precautions against

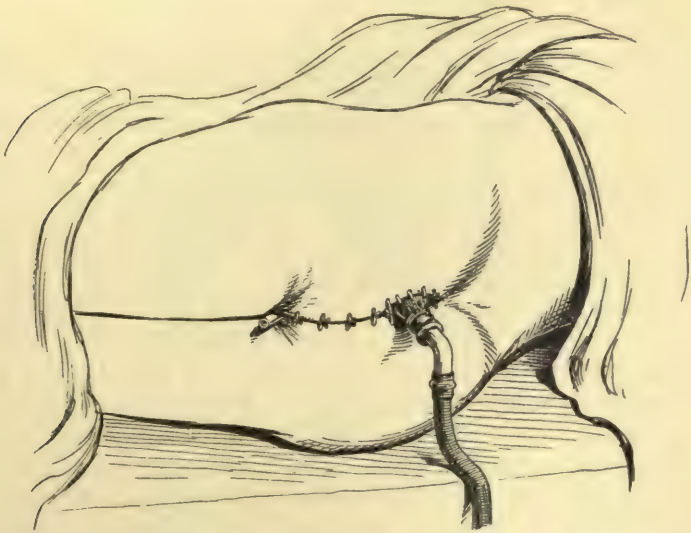


FIG. 203.—METHOD OF USING PAUL'S TUBE FOR EXCISION OF THE RECTUM. The bowel has been brought out and sutured to the skin and a Paul's tube has been tied into its projecting end.

soiling the wound, and then to tie in a Paul's tube, the lower end of which is fitted with the usual soft collapsible rubber tubing (see Fig. 203), and left projecting through the dressing. The Paul's tube separates about the fourth day, but in the meantime it allows the escape of gas, and of any fluid fæces which may be present, without any soiling of the wound taking place while it is *in situ*. In both plans about an inch of bowel is left protruding from the anus and this is trimmed off about a week after the operation.

After-treatment.– An injection of morphine is administered after the

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operation, and the usual measures are taken against shock (see Vol. I. p. 118). The bowels should be kept confined as long as possible by the use of opium—preferably in the form of laudanum—so that the healing of the wound may be fairly advanced when the first action occurs. Before this happens, all deep stitches should be removed so as to avoid infection along the stitch tracks; if no septic infection has occurred, the drainage tube should also be removed. After the bowels have acted, the dressings must be changed frequently, any fæcal matter being washed away by an irrigator. Should primary union occur, the patient will be well in three or four weeks; if any large amount of the wound has to heal by granulation six weeks or more may elapse before he can get about. When he begins to get up he should wear a pad fastened on with a T-bandage, but when the parts are quite sound he may be provided with a suitable apparatus. After an operation done in this manner the patient is usually comfortable if the bowels are not relaxed. An hour or so each morning must be devoted to ensuring a complete evacuation and thorough cleansing of the parts, and the patient may then go through the rest of the day without inconvenience; after the lapse of a considerable period he may even regain a certain amount of control, as the circular fibres of the bowel may assume a certain amount of sphincteric action.

2. Excision by the sacral route. — When the disease is situated high up the rectum, it cannot be removed satisfactorily by the operations already described, and for these cases Kraske introduced the method of removing portions of the lower end of the sacrum in order to get better access to the parts. Various modifications of his original operation have been introduced, but in all of them the removal of the sacrum does not go higher than the third sacral foramina so as not to injure important nerves, especially those which supply the bladder. The great disadvantage of Kraske's operation is that the glands are often imperfectly removed, and also a sufficient length of bowel cannot be taken away when the disease is high up. The result is that permanent recovery only takes place in a comparatively small number of cases. Another disadvantage is that the opening in the sacral region is difficult to manage unless the patient has some one to attend upon him.

This operation was at one time largely employed, but is now being replaced by the combined abdominal and perineal operation, by which the disease can be more thoroughly removed and the chances of permanent recovery proportionately increased; in addition, the situation of the new anus is more convenient. The mortality is, however, still considerably greater than that after Kraske's operation.

Kraske's operation is performed as follows:—

The patient is turned over almost on to the face with the left side of the pelvis a little elevated. A good plan is to place a large sand-bag over one end of the table and then to turn the patient over on his face

so that the pelvis rests upon the sand-bag; at the same time the left side is raised by a smaller sand-bag under the left anterior superior spine. The knees hang over the end of the table and rest upon a chair, whilst the foot of the table is raised so as to carry the intestines away from the pelvis. Another method of doing the same thing is to suspend the pelvis over a strap passed beneath it so that the patient is almost in the genu-pectoral position. It is important to arrange the patient so that there shall be no difficulty in breathing; a pillow should, therefore, be put under the chest so that the abdominal muscles can work freely.

The parts are shaved and disinfected, and a median incision is made

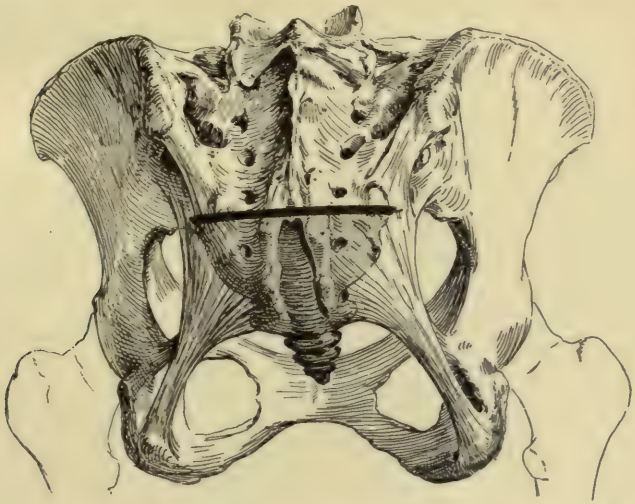

Fig. 204.—Line of Division of the Sacrum in Excision of the Rectum. The line of bone section runs just below the third sacral foramina. The coccyx is also removed.

from just behind the anus to the middle of the sacrum; the anus is closed by sutures before the operation is begun. The soft parts are raised from the coccyx, which is disarticulated and removed. The fat and fascia covering the levatores ani are then divided in the middle line throughout the whole length of the wound and the incision is deepened until the tissues outside the anal canal are reached. The levatores ani are now divided close to their insertion into the rectum, and, by pushing the fingers upwards behind the rectum, the tumour can be felt and its limits ascertained; it is now possible to determine how much of the sacrum must be taken away. If necessary, the posterior surface of the sacrum is cleared, the muscles and ligaments separated on either side, and the periosteum peeled off the front of the bone. The bone is removed with a chisel along a line drawn transversely below the third sacral foramina (see Fig. 202).

The rectum is now cleared up to the reflection of the peritoneum, along with all the fat and glands in the hollow of the sacrum, the peritoneal cavity is opened and the pelvic colon exposed. This is pulled down, the peritoneum being divided on each side as far as may be necessary, and the fat and tissues in the hollow of the sacrum brought down with it. The lateral vessels are clamped and tied as they are met with until the rectum has been cleared for a sufficient distance above the disease. The entire rectum with the tumour is now loose, except at the anus which has been left intact up to this point. If there is not sufficient length of bowel above the proposed point of division to reach to the anus without tension, the lower end of the bowel is dissected out in the manner described on p. 597, and thus the whole of the rectum, with the tumour and glands, hangs out of the posterior part of the wound. The anus is made just below the lower part of the sacrum in the manner described in connection with the perineal operation (see p. 600).

Occasionally it will be possible to leave the sphincter ani intact and make the anus in the normal position; but when the disease is high up it will be impossible to do this without dividing the bowel too near the growth; the same remarks apply to removal of the growth and end-to-end union of the divided ends of the bowel. In some cases, however, it may be possible to bring the bowel above the point of division down to the anal opening, and then the following procedure may be adopted. The sutures closing the anus are removed, and an incision is carried through the muco-cutaneous margin, as in Whitehead's operation (see p. 569), and the mucous membrane and submucous tissues are dissected up as far as the upper limit of the internal sphincter, where the wall of the rectum is tied with a silk ligature and cut across below it, and the mucous membrane, which has been dissected up, is removed. The rectum is now pulled down until the proposed line of section above the growth is just below the level of the anus. The portion of the bowel containing the growth is then cut away and the divided edge of the upper end is sutured to the anal margin. An excellent plan for pulling down the bowel is practised by W. J. Mayo (*Annals of Surgery*, Aug. 1912), who ties a tube into the divided upper end of the bowel, passes this through the anus (previously denuded of mucous membrane), and is thus enabled to pull down the upper end of the bowel to the anus, where it is stitched in place. The rest of the wound is stitched up, a drainage tube being inserted at the posterior end, and the further treatment is similar to that for the perineal operation.

In this method the lower end of the rectum is not only joined to the skin in the normal situation of the anus, but its end is embraced by the internal sphincter, so that some recovery of control may be looked for in suitable cases. The recovery of control is hardly complete, of course, because the nerve-supply of the sphincter—especially on the left side—is apt to be interfered with during the operation, but if a half twist is given

to the bowel the activity of the sphincter on the right side combined with this gives very fair control, and the result may be satisfactory. Unfortunately this method is only feasible in a small number of cases.

3. Excision through the vagina.—Excellent results may be obtained in the female by operating by this route in cases of malignant disease

FIG. 205.—INCISION FOR VAGINAL EXCISION OF THE RECTUM. The elliptical incision in the vagina is only used when the latter is adherent to the growth; otherwise a single straight incision is used. The mucous membrane of the anal canal is shown dissected up and occluded by sutures.

situated within four inches of the anus. The patient is placed in the lithotomy position, the vagina is douched with 1 in 2000 sublimate solution, and the anal orifice is occluded by carrying an elliptical incision round it, raising the mucous membrane and sewing its cut edges together with a purse-string suture of stout silk. The perineum is divided in the middle line from the posterior commissure of the vagina back to the

external sphincter in the first instance ; the anterior end of the incision is then carried up the posterior wall of the vagina nearly to the cul-de-sac (see Fig. 205). When the tumour does not infiltrate the vaginal wall, the latter is easily turned back on either side and the rectal wall exposed ; when there is any infiltration, an elliptical portion of the vaginal wall

FIG. 206.—BRINGING OUT THE LOOP OF THE PELVIC COLON IN VAGINAL EXCISION OF THE RECTUM. The peritoneum has been opened freely. The rectum has been only partially separated.

should be removed. When there is not sufficient space between the tumour and the sphincter to allow the bowel to be divided below the growth without fear of local recurrence, the anus is enclosed in an elliptical incision and the anal canal and the bowel are separated from the surrounding structures, as in the perineal operation. When, however, it is possible to divide the rectum between the growth and the sphincter, the latter

is left intact in the first instance and the surgeon proceeds to define the rectum and strip the surrounding structures off it with the finger and a blunt dissector. The levator ani is divided on each side, the reflection of the peritoneum is opened and the lateral reflections divided. As this is done the pelvis should be raised somewhat, so that the small

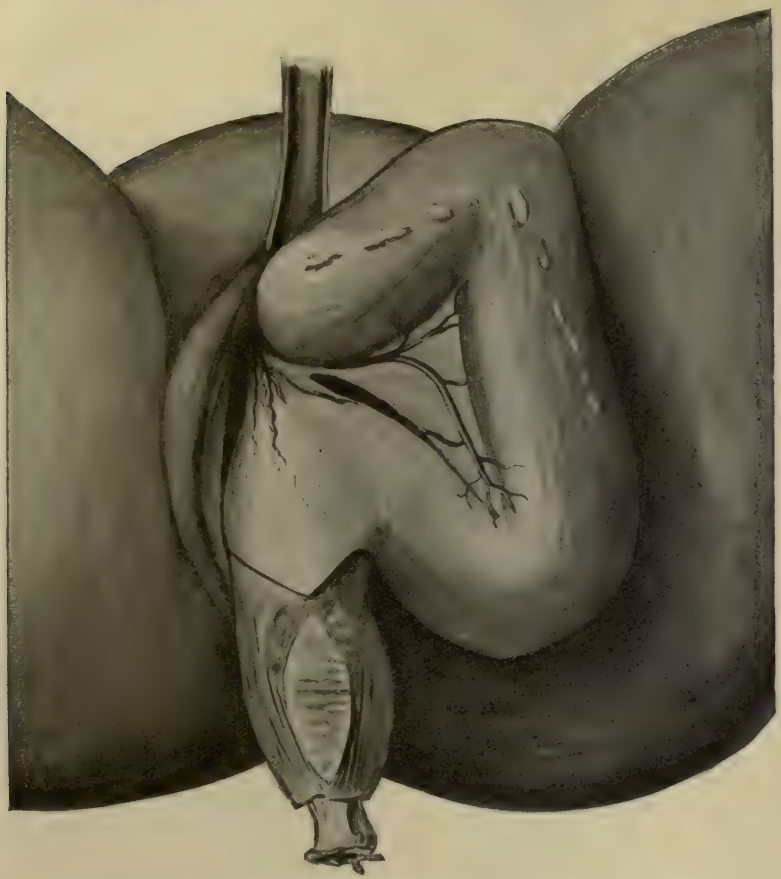

FIG. 207.—FREEING THE RECTUM PREPARATORY TO DIVIDING IT IN VAGINAL EXCISION. The rectum has been fully freed and the mesentery of the pelvic colon divided nearly up to the sacrum.

intestines fall away from Douglas's pouch. In order to make sure of getting well above the growth it is then a good plan to bring down the loop of the pelvic colon into the wound (see Fig. 206) so that the arrangement of the vessels can be studied with a view to dividing the bowel at a point which will not endanger the blood-supply of the portion left (see Fig. 207). The mesentery is divided right up to the sacrum ; the superior hæmorrhoidal vessels will have to be divided very cautiously between ligatures which are best passed on an aneurysm needle. The mesentery

is next divided downwards and the rectum proper is then isolated, together with the glands and fat in the hollow of the sacrum. If there is sufficient healthy bowel below the tumour, the incision already made around the muco-cutaneous margin is deepened as in Whitehead's operation (see p. 569), and the mucous membrane is dissected off the sphincters, and then, after plugging the rectum above the proposed level of division, is divided at the level of the upper border of the internal sphincter. The mucous membrane is now seized in catch-forceps and pulled down through the anus, and the upper end of the rectum and the pelvic colon is brought through the sphincters and stitched to the skin around the anus, about the proposed level at which the bowel is to be divided above the growth; if necessary, the skin at the anal margin can be loosened and pulled in, so as to reach the mucous membrane.

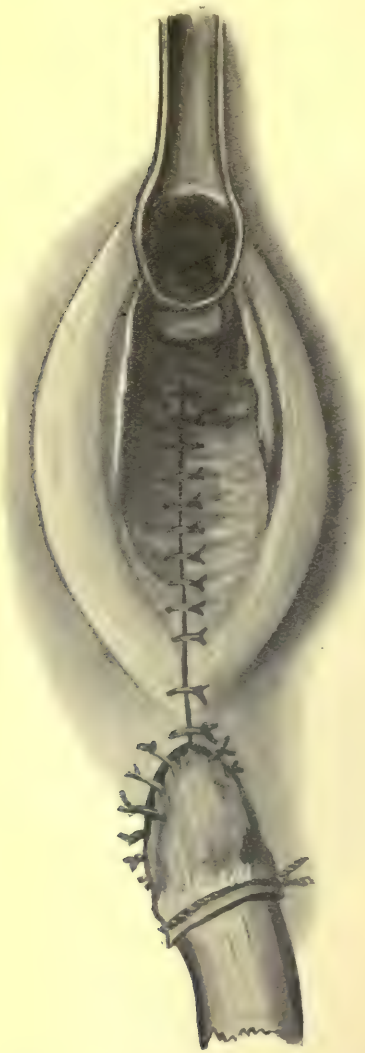

FIG. 208.—VAGINAL EXCISION OF THE RECTUM. The incision sutured. A tube is tied into the divided end of the bowel.

In stitching up the incision in the vaginal wall at the end of the operation, it is well to carry the stitches through the muscular coat of the bowel also; they thus hold the bowel down in position and prevent dragging on the anal sutures. The perineum is then repaired (see Fig. 208).

4. Excision partly or entirely through the abdomen.—This operation, which is being practised with increasing frequency, consists in opening the abdomen, detaching the rectum and the glands above the tumour as far as possible from above, dividing and ligaturing the vessels, dividing the bowel and sewing up the lower end temporarily, attaching the upper end to the abdominal wound so as to form an artificial anus, and, finally, dissecting out and removing

the rectum from below. The details of the operation vary according to circumstances, and three methods may be described: (1) When the whole operation is completed at one sitting. (2) When it is done in two stages. (3) When a preliminary colostomy is necessary in the first instance and the radical operation is performed at a later period.

In all cases the first stage of the operation is to open the abdomen. The patient is placed in the extreme Trendelenburg position and the abdomen is opened by a vertical incision through the left rectus from the pubis to the umbilicus. The condition of the rectum and the liver is now examined, and the possibility of a successful removal of the growth is estimated, while at the same time the extent of the glandular infection is noted. If now a colostomy is necessary it is performed. Should there be no possibility of a radical operation, either now or in the future, the colostomy opening is made through the laparotomy incision if possible; if the meso-sigmoid is too short to permit of this, a second incision is made laterally (see p. 379) and the sigmoid colon brought out through this in the usual manner. Should a radical operation be contemplated at a later date the colostomy opening should also be placed laterally so as to keep it as far away as possible from the anterior incision, which will have to be reopened at the second operation.

(1) *When the whole operation is completed at one sitting.*—The small intestines are packed out of the way, the upper part of the pelvic colon is pulled forwards—the meso-colon being divided, if necessary, in order to allow this to be done. The pelvic colon is clamped in two places at least six inches above the tumour and divided between the clamps. Each cut end is invaginated and closed by a purse-string suture, the lower end being wrapped in gauze and left *in situ*, and the upper brought out at the upper end of the wound or through a separate incision in the left iliac fossa, according to the proposed seat of the permanent colostomy opening.

The removal of the rectum and the tumour is now proceeded with. The fat and glands are separated downwards, and the superior hæmorrhoidal vessels are identified by putting the upper end of the rectum on the stretch, and are clamped, divided, and tied. The peritoneum is now divided on each side about half an inch from the bowel down to the reflection of the peritoneum on to the bladder; at that point the incisions are carried round to the front of the bowel. The peritoneum is separated on each side, and the ureters are stripped up along with it; the left ureter is the one most liable to injury. All the soft tissues are removed from the hollow of the sacrum, and the separation is carried as low down as possible—sometimes to the levatores ani—blood-vessels being tied as they are divided; the vessels will be the middle hæmorrhoidals, the middle sacral, and some branches of the lateral sacrals.

A sterilised cloth is now thrown over the abdominal incision, the patient is placed in the lithotomy position, and the anal canal and lower

part of the rectum are removed as described in connection with the perineal operation (see p. 600). This perineal incision is then sutured, a drainage tube being inserted at its posterior end, and the patient is replaced in the Trendelenburg position. The surgeon changes his gloves and sews up the peritoneum in the pelvis, and either closes the wound in the abdominal wall completely, forming the artificial anus laterally (see p. 379), or closes the wound partially, and forms the colostomy opening at its upper end.

In a few cases, in which the disease is situated fairly low down, it may be possible to leave the anal canal and bring the upper part of the pelvic colon down through it (see p. 604), and thus avoid a colostomy. To allow of this it may be necessary to divide the inferior mesenteric artery below the origin of the colic branch so as to free the iliac colon.

(2) *When the patient is very feeble*, it may be deemed advisable to divide the operation into two stages. After the bowel has been separated from above and pushed down into the pelvis, it is covered with a thin sheet of sterilised india-rubber and the peritoneum closed over it, the abdominal incision stitched up, and a colostomy opening made as above described. Three or four days later, the rectum is dissected out from below. The objection to this procedure is that it seriously interferes with the circulation in the upper part of the rectum, and fatal gangrene or perforation may occur in the interval between the two stages.

(3) *When there are obstructive symptoms*, or for other reasons already mentioned (see p. 594), a preliminary colostomy may be advisable some days before the radical operation is performed. In that case an incision is made through the rectus as already described, and the local condition examined in order to determine whether a radical operation is advisable or not. If it is, a lateral colostomy is performed (see p. 379) and the first incision closed. The reason for making the colostomy opening laterally is because the anterior incision must be opened for the subsequent radical operation, and the colostomy opening must be some distance away from it.

When the time comes for the radical operation, the colostomy opening is plugged with gauze and the skin brought over the plug with two or three stitches, and thoroughly cleansed and disinfected. The median incision is opened up, the bowel clamped and divided near the seat of the colostomy, both openings closed in the usual manner, and the operation proceeded with as described on p. 608.

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